SCIENTIFIC AMERICAN

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

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ELECTRICALLY-FIRED GATLING GUN.

We illustrate in the present issue a new application of the electric motor, in which it is caused to operate a Gatling gun. This well known type of mitrailleuse has been placed on many of the U. S. naval vessels, and represents a very powerful weapon for repelling attacks and for general fighting work at close quarters.

Hitherto the Gatling gun has not been automatic. The loading is effected by turning a crank attached to the breech mechanism of the piece. As this causes the barrels to rotate, they are discharged one at a time. Ten barrels are comprised in the piece, so that for each revolution ten shots are delivered. While one man turns the crank, a second man holding the tail stock or lever may be employed in directing and aiming the piece, if continual change of direction is needed. While this character of manipulation is often required, and is that by which rapid-firing guns should perform the greatest execution, it has attendant difficulties. The turning of the crank inevitably causes the piece to oscillate and adds a second disturbing element to the vibration due to the recoil.

The Crocker-Wheeler Motor Company, of this city, were invited by the U. S. Navy Department to arrange an electric firing mechanism for the Gatling gun. Several requirements had to be kept in mind in producing the design. The apparatus had to be attached to the barrel of the gun so as to move with it. It had to be out of the sighting line, and it was necessary to dispose of it so as not to interfere with elevation or depression of the gun. The motor finally had to be adapted for operation by the electric lighting plants as installed upon the ships of war. The drawings show clearly how the problem has been attacked.

Upon the left hand side of the breech of the gun an open frame of generally rectangular outline is secured. Within it is placed the motor. This is a specially wound motor, adapted for an electro-motive force of 80 volts, and a current of 3 to 3½ amperes intensity. This, it will be seen, represents the absorption of a little over ⅓ electric horse power. The efficiency of the motor is placed at over 80 per cent. The spindle of the armature, which in general terms runs horizontally and at right angles to the axis of the gun, carries a pinion which engages a large gear wheel. The latter is inclosed in the cylindrical or disk-like case which is seen next to the motor by the side of the breech. The spindle of the large gear wheel is prolonged across the end of the gun barrel, and carries a worm at its end. This gears into a worm wheel on the working spindle of the gun.

This double reduction of speed causes the operation of the gun at about 150 revolutions per minute, giving 1,500 discharges. This rate is rather high for general practice and can be considerably reduced.

A small switch is provided for turning the current on and off. The artillerist, after starting the motor, is free to swing the piece in any direction. This he can do without interference from a second operator and the gun is undisturbed by the shaking due to the turning of the crank.

Between the motor and the large gear wheel is a clutch by which the motor can be connected or disconnected from the breech mechanism. The crank by which the piece is worked by hand under the former conditions is arranged for rapid disconnection or reconnection. This provides for injury to the electric apparatus. If the latter becomes disabled or if its connections are severed, the clutch can be thrown open and the handle connected, when the gun will be ready for operation by hand. This change takes only a few seconds. This application of electricity is of special interest as bringing the Gatling gun into the rank of automatically fired artillery.

Dr. Koch's Cure for Consumption.

A Berlin correspondent of the *Pacific Medical Journal,* writing about the recent medical congress held in that city, says: Following Sir Joseph Lister came Prof. Dr. Robert Koch, who was enthusiastically received.

His paper had reference to a cure for consumption with which he was experimenting. Dr. Koch was shrewd enough not to name his "cure," so we did not learn much from the distinguished director of the Hygienic Institute of Berlin. The rest of Prof. Koch's address was a *resume* of bacteriology. He said, "Public opinion was at first against the germ theory, and it is necessary to prove in all cases that the disease and the micro-organism in question appear *together*, and that the germ does not appear in any other disease, and that the same micro-organism, propagated outside of the body through several generations, *always* produced the same identical result if it got into the system.

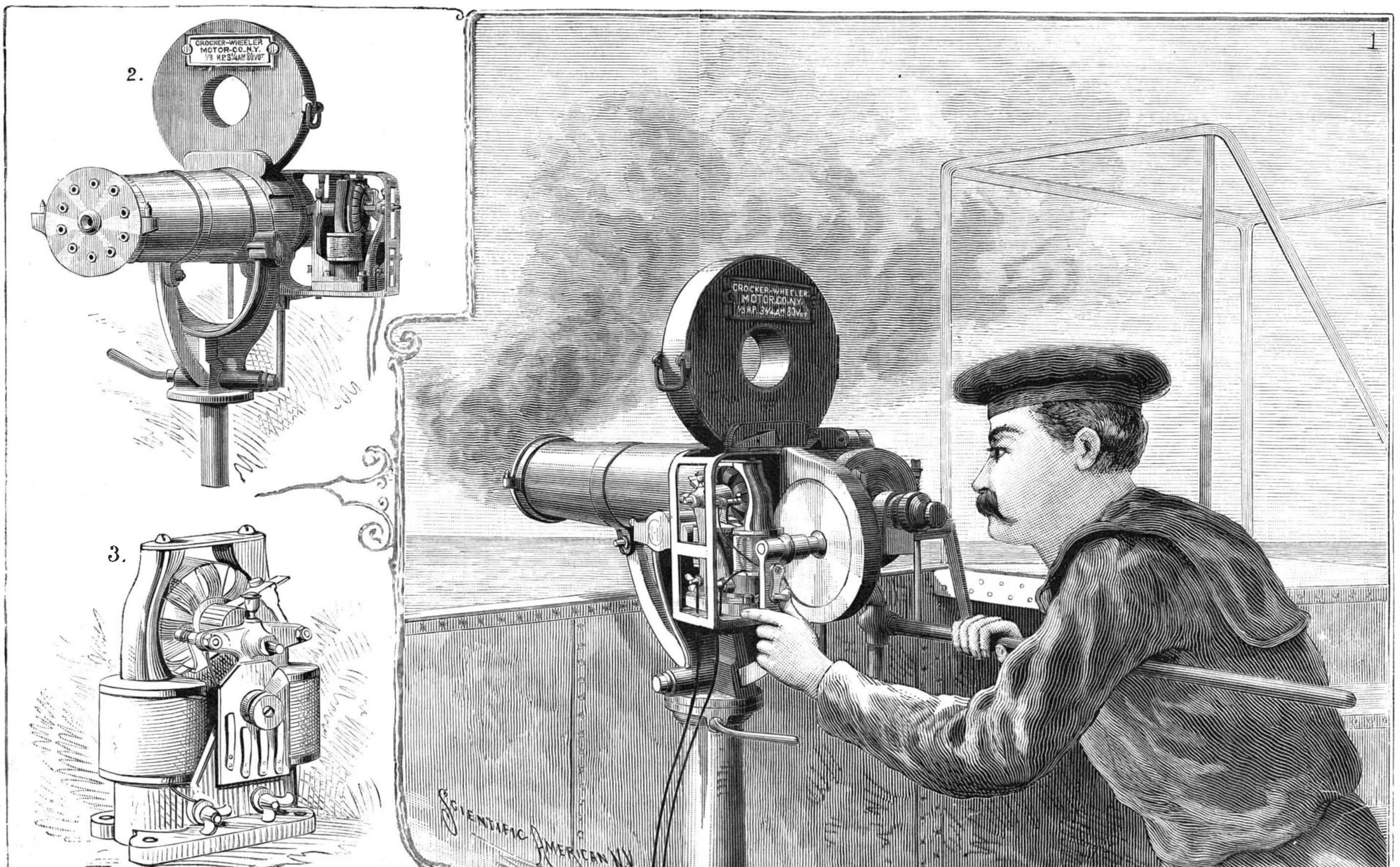
"This had been proved in anthrax, tuberculosis, and erysipelas. But it has still to be proved in the case of typhoid fever, ague, leprosy, diphtheria, and Asiatic cholera; nor had the specific bacterium been proved in scarlet fever, smallpox, yellow fever, cattle plague, pleuro-pneumonia, influenza and *hydrophobia.*" Prof. Koch then mentioned that the most recent discovery in bacteriology was the poisons excreted by the bacteria. These poisons were now regarded as the immediate cause of death.

For years past Prof. Koch has been seeking a cure for consumption. He began by pure cultivation of the bacillus, and found ethereal oils, tar pigments, mercurial vapors, salts of gold and silver, and especially cyanide of gold efficacious in destroying the germ, *but this could not* be done in the *body* of animals without also destroying the animal.

"I continued my search, however," he continued, "and at last *found what I sought!* Susceptible as the guinea pig is to the tubercle bacillus, it proved *non-inoculable* when treated with the substance in question. Even when the disease was *far advanced* it could be brought to a standstill by this means."

This fact may give occasion to search for similar effective remedies in other infectious diseases also, and here lies the field for an international contest of the highest and noblest kind.

After prolonged and enthusiastic applause the meeting adjourned.



1. The gun in operation. 2. The gun and electrical attachment. 3. The Crocker-Wheeler motor.

FIRING GATLING GUNS BY ELECTRICITY.

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ZAPON, A SUBSTITUTE FOR LACQUER.

An important feature of all fine mechanical or ornamental work is the final finish. Beauty of design is insufficient to secure a pleasing result where finish is neglected. Lacquering has usually been resorted to for beautifying and protecting metallic surfaces, but lacquer requires a dexterous hand for its successful application, and it is not permanent under all conditions.

It will be of interest to our readers to know that a superior substitute for lacquer, known as zapon, has been perfected by the Frederick Crane Chemical Company, of Short Hills, N. J. This new article is being largely used by manufacturers of metallic goods and instrument makers. It is also used on sheet metal ware and on wood. It is flexible, very permanent and not easily scratched. It has other advantages which will be appreciated by the novice, *i. e.*, it dries without heat, and does not show streaks or brush marks.

Zapon is made both colorless and of all colors. It is used on brass, copper, silver, iron and other metals, and is applied either with a brush or by dipping. Among the products of this establishment are brilliant and black enameloid, the first being an excellent substitute for baking japan, while the second—the dead—is applicable to artistic iron work and to various uses in connection with photography and optical instruments.

HOW TO ESTIMATE OUR WORK ON WAR VESSELS.

Now that we have made so substantial a commencement on our new navy, it may be interesting to ask, What has been actually accomplished by foreign powers in expending immense sums on war ships during the past twenty-five years, while we have done comparatively nothing? The triple-screw protected cruiser, No. 12, for which the contract has recently been awarded, to be of 7,400 tons displacement, with a horse power in excess of 20,000 and a speed of not less than 21 knots, marks the present limit of our investment in this line of vessels, and, with the contracts at the same time awarded for three large armored battle ships, we substantially enter the field in which the great European powers have been competing against each other ever since the guns of the little Monitor were heard in Hampton Roads. Of the other armored vessels being built, it may be said that, although not intended as the equals of first-class foreign war ships, they will, owing to their more modern construction, fill a very important minor position, while in high-speed cruisers our place will probably be second only to that of Great Britain.

The absence of any practical tests, in actual war, of the great ships on which so much has been expended by England, Italy, France and Germany, leaves open a wild field for judgment as to what their ultimate efficiency will be. A valuable aid in forming such judgment, however, is afforded by a paper recently published by W. Laird Cowles, entitled "Naval Warfare, 1860-1889, and Some of its Lessons."* The writer considers the subject under the divisions, (1) speed, (2) the ram, (3) high explosives and torpedoes, (4) armor, and (5) guns and their role in action.

The experience of the vessels in the war between Chili and Peru is quoted to show that speed is important to enable a ship to bring her enemy into action, but will never enable her to beat him. The Huascar rammed the Esmeralda and sank her, but not until the latter's engines had been rendered powerless, while the 12 knot Independencia tried to ram the 5 knot Covadonga, but the slower craft easily slipped away, leaving her enemy to run upon a rock. In the battle off Lissa, in 1866, when over forty vessels were engaged, many efforts were made at ramming, but the only successful one was upon a vessel, the Re d'Italia, previously disabled by gun fire. Many incidents of our own war and of the Franco German war are also quoted to show that a ship, so long as she can keep way on her, and can steer, need not fear an enemy's ram, while if ramming is tried before the enemy is disabled, the vessel trying it may be torpedoed in passing, and has added liabilities to other injuries.

Torpedoes, as thus far employed, are declared to be almost as fatal to their users as to those against whom they are used. In the war between Chili and Peru the Huascar endeavored to use a Lay torpedo, which turned back on its course, and would have struck the vessel from which it was sent, had not an officer jumped overboard and guided the machine aside, after which the commander buried the rest of his torpedoes in the cemetery at Iquique. The author's conclusion is that with good care and a careful lookout a ship not actually in action with other ships can generally protect herself from torpedoes.

As regards armor protection, it is difficult to overrate its value, provided the armor be thick enough to absolutely keep out heavy projectiles, and especially shells, while it is hard to overrate its danger if the armor be so weak as to permit projectiles either to pierce or shatter it. The ship's engines and boilers should be protected at all hazards, as a modern ship that cannot move in action is doomed, no matter how powerful she may be; but all armor has such definite limitations—all of which may be overcome by the heaviest guns—that armor is at best only a compromise. Speed, the ram, and high explosives, are accounted factors of secondary importance, while the main factor has conspicuously been gun fire.

This is divided into two kinds, that from slow and heavy guns, to act against the enemy's material, while the light gun fire includes that from quick-firing and machine guns and from rifles—to deter the enemy from manning his light guns, to throw a hail of projectiles into his ports, and to riddle his unarmored ports. This is a business which to be successful must be thoroughly carried out by one party to the action from the very commencement of an engagement, when even the heavy guns of its opponent can only be fought with difficulty, and therefore it is claimed that, where two forces are otherwise anywhere nearly equal, the force which earliest obtains and preserves the superiority in light gun fire will ultimately be the victor. The quick-firing gun, however, is not only a gun to work against the enemy's men, but takes rank among pieces designed to pierce armor. The fire from a six inch quick-firing gun is capable also of disabling the heaviest guns when the projectile is rightly directed, for many of these heavy guns are of such great size that they have to be largely if not wholly unprotected. The general conclusion is, therefore, that too many very heavy guns have been employed, greatly to the detriment of the ship's efficiency—that a ten inch gun, which will pierce a thickness of twenty inches of armor at 1,000 yards, is practically about as large as should be employed on a ship, and that there should be few guns of such size, and a larger proportion of machine and quick-firing guns.

As singularly confirming these views, the British Admiral of the Fleet Sir Thomas Symonds writes that, besides their inferior compound plates, British ironclads have "other faulty arrangements greatly detracting from the fighting power and safety of ships wrongly classed as ironclads, in which untrustworthy monster guns have been mounted in enormously heavy turrets and barbettes, and thick patches of armor added to protect their unreliable hydraulic machinery. The awful overweighting of our modern battle ships with monster ammunition, etc., also reduces greatly their seagoing safety. Whether we regard our guns, our ships, or our armor, the lack of a wise and definite policy is evident."

Perhaps it is not so strange that what all would acknowledge to be a "wise and definite policy" has not heretofore been settled upon, for the whole period of the modern war vessel has been an exceptionally transition one, as have all processes connected with the manufacture of iron and steel. It may well be presumed, however, that the expensive experiments and costly mistakes of our neighbors across the Atlantic will be fully availed of in the construction of our new navy, the delay in commencing substantial work upon which for so many years has been so generally deprecated.

* SCIENTIFIC AMERICAN SUPPLEMENT, No. 772.

DR. KOCH'S CURE FOR CONSUMPTION.

Great interest is being everywhere manifested in the reports now coming from Europe concerning the alleged discovery by Prof. Koch, of Berlin, of a method for the cure of consumption by inoculation. Dr. Koch announced his discovery of the tubercle bacillus as a living germ in 1882, and it now appears that he has so far succeeded in producing the tubercular bacillus as to be willing to employ it practically on those afflicted with consumption, although it is announced that only leading bacteriologists and physicians can be admitted to a knowledge of the preparation of the lymph, as it requires the most thorough care and a high degree of skill.

It is said that about one fourth of all the deaths occurring among human beings during adult life are caused by consumption, or pulmonary tuberculosis, a disease of the same nature also prevailing to a great extent among cattle. It is produced by living germs finding their way into the body, generally attacking the lungs first, where they multiply under favorable conditions and throw off new growths, the discharges from which contain also the living germs. The latter, however, do not grow outside of the human or animal body, except under artificial conditions, although they may long retain their vitality, to again reproduce themselves when received into the body. It is thus that consumption is most often produced by breathing air in which these germs are suspended as dust.

It is on these germs that Dr. Koch has been experimenting to produce, by artificial propagation, a bacillus of milder form, which, on being introduced into the system, as by inoculation, would overcome and eradicate the more dangerous bacilli causing the disease. The experiments have been substantially in the same line with those of Pasteur relative to the cure of hydrophobia, Dr. Koch having been one of the first to acknowledge the efforts of Pasteur in this field, and having aided largely in the successful development of the Pasteur theory and practice.

The Charity Hospital, at Berlin, has been the scene of Prof. Koch's experimental work, although it is said that he has already had many patients of high social standing, and achieved some remarkable success. The accounts thus far received say that the patients have been pledged to secrecy as to the method of treatment, which would be somewhat strange were it not for the fact that the announcement is also made that Dr. Koch is preparing for publication a work fully explaining his discovery. It may well be that he is afraid more harm than good would come from the getting abroad of any partial or incomplete understanding of it, which might lead incapable or indiscreet practitioners into ineffective attempts to follow his line of practice. It is said that in cases now under treatment a change for the better is observed after five or six injections of lymph, within a fortnight, although one case of long standing required a month to effect an improvement. From four to eight weeks is thought to be the time that will be required to effect an ordinary cure. It is announced that before six months all the patients now under cure will have passed through the period of observation, and that then Prof. Koch will be able to publish his discovery to the world.

Highs and Lows in the Atmosphere.

H. A. HAZEN.

It is intended in this paper to set forth some facts tending to answer the question, What are HIGHS (elevations) and LOWS (depressions) in the atmosphere? The term anticyclone for a high pressure area seems a misnomer, and the term cyclone, for a storm, first applied by Piddington to the violent storms in the seas north and south of the equator, should be used in connection with these storms. These terms here suggested apply exactly to what we see on our weather maps and, till we know more about the mechanism of these phenomena, they may be regarded the most concise and satisfactory that can be used. The so-called permanent HIGHS and LOWS, for example, the winter HIGH in Siberia and the permanent LOW over Iceland, are not included in this discussion, nor are thunder storms, tornadoes, water spouts or any such phenomena included, since they are known to be secondaries usually 400 or 500 miles to the southeast of the center of a general LOW and have very few of its characteristics.

Every one is familiar with these HIGHS and LOWS as they move rapidly or slowly one after another across the country. We are taught that in a HIGH the air is denser and cooler; this has a tendency to cause a flow of air to its center and there to raise th pressure. If anything, there is a slight tendency downward in the air, and this also serves to raise the pressure. There is also a tendency to whirl from left to right. In a LOW the air is less dense, it is much heated, is full of moisture, and there is generally an uprush in the center as well as a whirl about it; all these conditions serve to diminish the pressure. Also the uprush at the center carries moist heated air to the cooler upper regions, and by expansion a still farther cooling is effected, which causes a condensation of the moisture and precipitation. This condensation, however, liberates latent heat, and this in turn heats the air and causes greater rarefaction, which in its turn causes a greater uprush, and this may continue till a most violent disturbance ensues. The fact that rain does not fall at the center, where Espy supposed it did, but 400 miles or more to the east and southeast in the United States, while in England a little more falls to the west than to the east of the center, would seem a serious objection to this view.

We may consider this whole question under several propositions:

1. *Highs and Lows have a common progression or velocity.*—This seems self-evident, for, if they had not, the one would overflow the other. It is not intended to imply that these conditions 2,000 miles apart, more or less, have a common velocity, but, as they pass along one after the other, their movement must be practically the same, and when the velocity of one changes, the other must also.

2. *There is no whirl in either, a few thousand feet above the earth.*—Observations of clouds have shown this fact beyond a doubt, but the records for over seventeen years at the station on Mt. Washington, N. H., 6,300 ft. in height, are absolutely conclusive on this point. There is no veering of the wind at this station such as is noted at the earth's surface, in fact, an east or northeast wind is a most rare phenomenon; over 90 per cent. of the winds are from a westerly direction. Some have gone so far as to declare that this proves that the centers of the great majority of HIGHS and LOWS must be below 6,300 ft. Imagine a disk 6,300 ft. high and 3,000,000 ft. in diameter whirling round and round, and at the same time carried horizontally from west to east. Suppose we heat up the front (east) part of the disk, how many minutes will it be before the whirl will carry this warmer part around to the west and bring the cooler to the east? Now we know that the east and southeast part of this LOW continues warmer than any other part, and the west and northwest cooler, a condition which would be impossible if there were a whirl.

3. *The centers are far above our highest mountains.*—This proposition is of great importance, and if it could be positively settled, would clear away many difficulties. It is thought by some that since in a LOW there is a great increase of temperature in the lower layers, there must be a relative increase in pressure as we rise in the atmosphere, and hence in a very short distance we would reach the so-called "neutral plane," above which there would be an increase of pressure. Observations show that no such condition exists, and that, on the passage of a LOW, the pressure falls just as much at Pike's Peak, for example, relative to its height, 14,134 ft., as at the base. This shows that the condition making the change in pressure is far above three miles in height. It will be shown shortly that temperature changes with HIGHS and LOWS on our highest mountains are exactly the same as at the base, and this also proves that the center of the condition producing the changes must be far above these mountains.

4. *There is no movement of air or moisture particles by air currents in a vertical direction in them.*

The theory of an uprush in a LOW is the most tenaciously held of any in meteorology. It is the *primum mobile* of all views of storm generation. There is not one scintilla of evidence that such an uprush exists except in imagination. One or two reasons for denying this have already been given, one other only is here noted from many. Since there is friction with the earth, the lower part of this uprush would lag far behind the upper, and in a very few minutes the verticality of the uprush, upon which alone its integrity depends, would be entirely obliterated and the whole movement quickly brought to rest. To say, as some do, that the upper part of this uprush separates off and goes gyrating ahead of the lower part, and afterward communicates its gyrations through a frictionless medium to the earth, seems very strained. Computation has shown that it would require over 20 years for such gyrations to pass vertically through 300 feet in a frictionless medium.

5. *There is no extended horizontal transference by air currents of material particles in them.*

This is probably the most important proposition of all that can be advanced, and it will be the one hardest to accept by those who have been taught that our LOWS are enormous whirls transported in the drift of the upper atmosphere. The truth of this proposition is shown by the fact that while the LOW travels, in the United States, in winter, at the rate of 35 miles per hour, the wind rarely attains half that, and even then the wind does not blow steadily from the west. It is easy to see that if the wind were blowing at the rate of 35 miles per hour in front and toward the LOW, the velocity of particles in the LOW toward the east would just counterbalance this motion, while on the west side, if the wind blew straight toward the center, the velocity should be 70 miles per hour, but we know that the wind velocity is nearly uniform on all sides. Again, in a HIGH having the same velocity, about 35 miles per hour, there is almost a dead calm. In this journal for January 18 of the present year I have shown that one of the most important characteristics of a storm is an enormous increase in the dew point or amount of moisture over thousands of square miles in front, while there is as great a decrease in the rear. These effects are in no wise due to heat, winds, evaporation or any other cause acting at the earth. I have also found that the diminution in the rear cannot be due to the advance of a HIGH with cold dry winds, because it often takes place when that does not follow up the LOW.

It is probable that this drying takes place at some height in the atmosphere first and works down. Whatever it is, it cannot be due to the onward movement of air particles, now full of moisture and almost immediately after with the moisture sucked out, as it were. It is well known that it is one of the most difficult things to either saturate air or deprive it of its moisture.

It would seem as though such transference of particles were improbable, but it may be asked, how can the changes be brought about by the HIGH and LOW if they do not travel? May we not consider these phenomena the result of another action? Suppose we have two spheres 1,000 feet in diameter carried through the air at a height of 1,000 feet, the one very hot and the other very cold, and we had thermometers delicate enough to register changes in temperature of the air at the earth, the resulting phenomena would be exactly those that we now observe on the passage of a LOW and HIGH.

6. *They are almost entirely independent of the drift of the atmosphere, though they may affect that.*

It will be conceded, on all sides, that the clouds drift in the atmosphere. This drift is almost invariably from west to east, but we often notice our HIGHS and LOWS changing position from north to south. The best proof of this proposition, perhaps, is to be found in mountain observations. As a HIGH approaches, the drift or wind at the mountain station dies down and becomes about half the apparent motion of the HIGH, while with the approach of a LOW the drift increases to nearly double the motion of the LOW (see *Journal of Franklin Institute*, July, 1888). Now, as we have just seen, the progression of the HIGH is practically the same as that of the LOW, so that, if anything, the drift of the atmosphere is changed by the progress of HIGHS and LOWS instead of their motion being dependent upon the drift.

7. *They are independent of temperature changes both above and below, and, in fact, bring about the latter.*

This proposition comes next to 5 in importance, and is really established by that. If it can be sustained, it gives the death blow to most modern theories of the generation of the HIGHS and LOWS. We find exactly the same temperature changes at our highest stations as at the base, and hence it is very evident that the center of influence in the HIGH or LOW must be far above our highest station, or more than three miles above the earth. It is possible that the conditions producing our HIGHS and LOWS extend to the limits of the atmosphere. We are taught that the sun heats up a limited portion of the earth, and this in turn heats the air, and the air above is heated layer by layer; while there may be a limited action of this kind, yet it is evident that that could not account for more than a small fraction of the heat in our LOWS, and it would not account at all for the cooling in the HIGH. Some think that the air near the earth becomes heated, and this starts a rush of air upward, but it is very evident that such a motion of a warmed particle cannot be maintained as we have seen under 4.

8. *They are independent of direct heat influence from the sun.*

This is plain in the case of HIGHS, since they show a lack of heat, and it is also true for LOWS, since they have a continued heat action through the night. The fluctuations in temperature on the advance of a LOW are much greater in winter than in summer, though it is plain that the sun's influence is very much greater in the latter case.

It will be seen at once that these 8 propositions are largely negative, and that we have advanced very little in our studies regarding HIGHS and LOWS. It is plain that nearly all of them are most intimately connected, and must stand or fall together. No attempt has been made to theorize, but it has been my desire to present facts as simply as possible. If any one has been led to think of these things, and will enter upon a discussion of this interpretation of the facts, I shall be entirely satisfied.

Anchoring Bolts into Stone.

The *Engineering and Building Record* quotes from a letter to the Troy *Polytechnic* some interesting particulars about the usefulness of various substances for anchoring bolts into stone. It was necessary in the construction of an elevated railway, in a place where the line led over rock, to anchor the foundation by bolts to the ledge, and in view of the expense and other objectionable qualities of sulphur and lead for this purpose, it was resolved to try whether cement could not be made available.

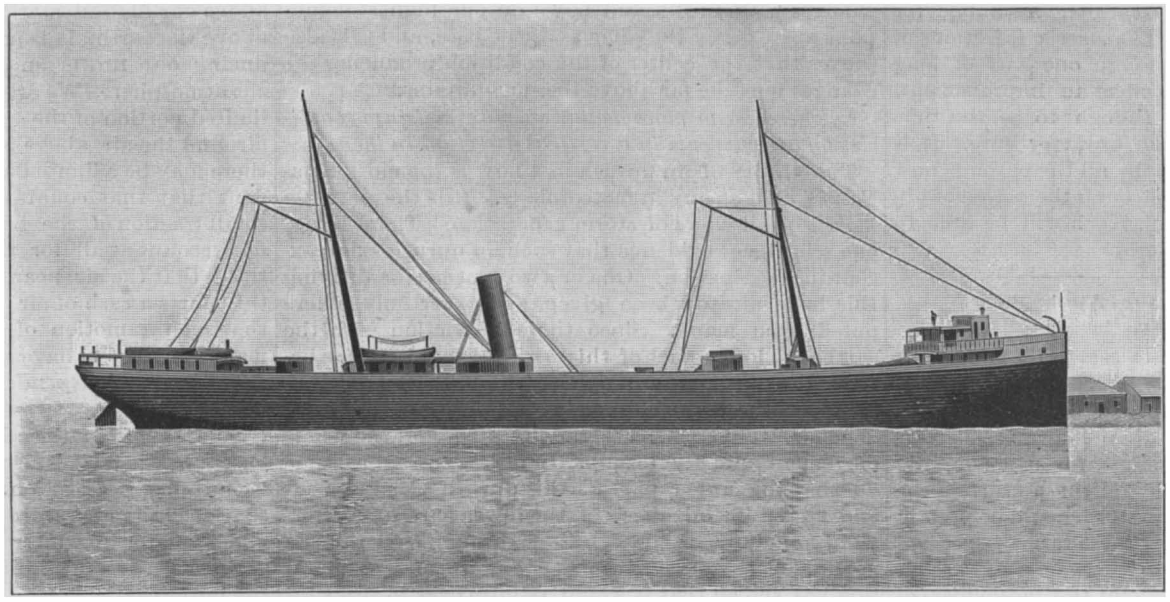
To test the question 14 holes were drilled in a ledge of limestone rock, all 42 in. deep, and bolts, some ¾ in. and some 1 in., were set in the holes. Around four of the bolts sulphur was then poured, lead was put in around four more, and Portland cement, mixed neat, around the remaining ones. Two weeks later the bolts were pulled by a powerful lever. Out of those run with sulphur, one was drawn out under a strain of 12,000 lb. With the others the iron yielded before the sulphur gave way. Three of the bolts calked with lead also broke in place, one pulling out; but of those set in cement, one yielded slightly and then broke, while all the others broke in place, showing that Portland cement is not only cheaper for setting iron into stone, as well as less likely to corrode the iron, but is stronger and much more easily applied. This account reminds us, the journal above referred to adds, of a little experience of our own, which has a certain interest.

In the construction of a building where external anchors are used, some of the bolts, which were built through the walls, were sent, by a mistake of the maker, with the ends cut for wood screws, instead of being threaded for a nut. As the work was being hurried, and there was not time to wait for others, they were used, on the assurance of the maker that he could fit nuts to them. After the walls were ready for the anchors, it was found that no machine was made which would tap an iron nut to fit a wood screw, and the manufacturer made nuts of Babbitt metal which were forced on the screw. They were rejected by the architect on account of the softness of the metal, and a bolt, with the nut, was tested at the Watertown Arsenal, on the Emery testing machine, to determine the resistance of the nut. The bolt was pulled in one direction, and the nut in the opposite one, and neither yielded until a force of 5,600 lb. had been applied, when the nut burst, the threads stripped, and the bolt pulled out. The bolt was ¾ in., somewhat deeply cut, so that the resistance of the nut was about three-quarters of the strength of the bolt, and if it had been made thicker, the iron would probably have yielded before the soft Babbitt metal.

UTILIZING scrap steel rod by welding it and drawing it into fence wire is one of the recent successes of electric welding.

LAKE STEAMERS BUILT BY A CLEVELAND FIRM.

During the past nine months the Globe Iron Works Company, of Cleveland, O., has been building steel steamers of the class shown in our illustration, for the freight business on the great lakes on our Northern border, at the rate of about one steamer a month. This business will compare favorably with that of any other shipbuilding firm in the world, being exceeded, probably, in only one or two instances, for these steamers have a carrying capacity of about 3,000 tons each. The vessel shown is of the same style as eight others built during the present year, and has a length of keel of 296 feet; length, over all, 312 feet; beam, 40 feet; moulded depth, 24 feet 7 inches; draught, 15 feet 6 inches. Her engines are triple expansion, with cylinders 24, 38, and 61 inches in diameter respectively, and with a 42 inch stroke. She has an independent air pump condenser. Her wheel is sectional and 14 feet in diameter, with a lead of 17 feet. She has two boilers of the Scotch type, each 14 feet in diameter and 12 feet 6 inches long, with three furnaces, the boilers being designed to carry 160 pounds pressure. She has eight loading and two fueling hatches, with steam windlass and capstan forward, steam capstain aft, and steam steering apparatus. Like all the other boats of this class, she does not carry any canvas.



A REPRESENTATIVE FREIGHT STEAMER ON THE GREAT LAKES.

The tonnage of vessels built upon the great lakes has shown a remarkable increase within the past two or three years, and there are striking indications that the growth will be even more pronounced in the next two or three years. As reported by the Bureau of Statistics of the U. S. Treasury, the tonnage built on our Northern lakes for the fiscal year to July 1, 1889, was 107,080, while for the fiscal year 1887 it was but 56,488. The vessels built on the Mississippi River and its tributaries for the year to July 1, 1889, foot up, by the same authority, to 12,202 tons, those built on the New England coast to a tonnage of 39,983, while the entire seaboard, Atlantic and Pacific, contribute a tonnage of 111,852, or an amount very slightly in excess of the tonnage put afloat on the great lakes. The largest amount of tonnage ever built in any one year on our entire seaboard was 310,421, in 1864. In that year there was built on the great lakes 49,151 tons, and the total was 415,741 tons, against a total of 231,134 tons the past year.

Proposed Tunnel between Ireland and Scotland.

A public meeting, convened by the mayor of Belfast, has been held to consider a scheme for constructing a tunnel between Ireland and Scotland. Mr. Barton, civil engineer, submitted his scheme, which is to construct a tunnel from the junction of the Belfast and Northern Counties Railway, four miles inland from Whitehaven, on the Antrim coast, to the center of Wierston Hill, in Wigtonshire, also about four miles inland, the whole length to be about 34 miles. The scheme has the support of Sir Douglas Fox, engineer of the Severn Tunnel, Sir Benjamin Baker, the Forth Bridge engineer, and Sir John Hawkshaw, of London. He estimated the total cost at £8,000,000, and the tunnel could be completed in ten or twelve years. The meeting passed resolutions recognizing the importance of the scheme, urging the government to render financial assistance, and appointing a committee to consider and report upon the whole question.

How Time is Distributed by Telegraph.

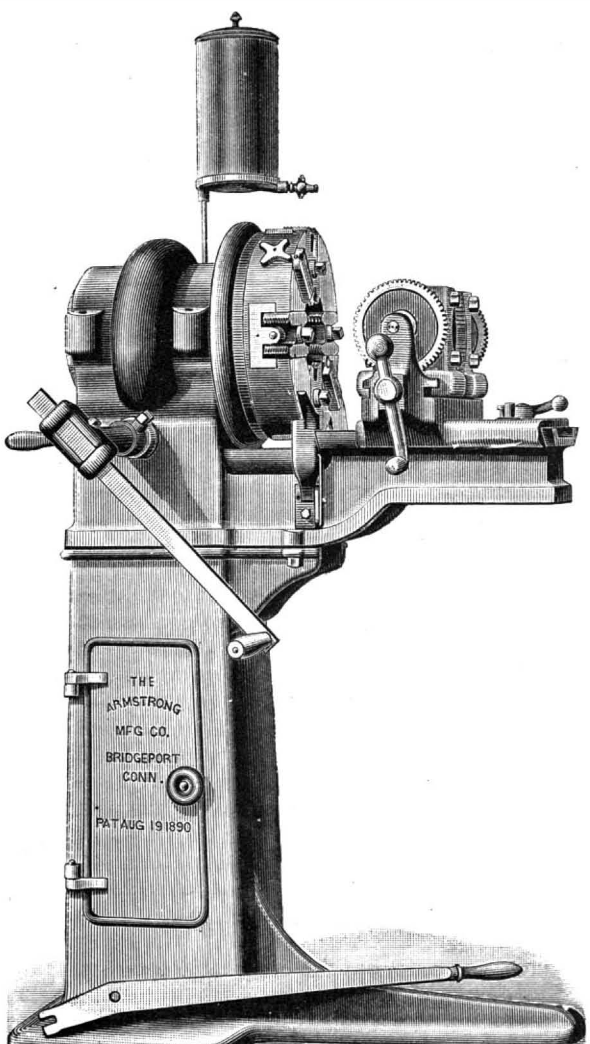
The Naval Observatory at Washington considers it an important part of its business to determine and give away to any one who chooses to ask for it absolutely correct time at noon each day. Experts paid by Uncle Sam make the computations and press the button at precisely 12 o'clock, thus communicating the hour to the various departments in this city. The Western Union is permitted to have its instruments in the room whence the message is sent, with an attachment to the button, so that the news is flashed directly from the observatory without even the aid of an operator all over the United States, reaching even so distant a point as San Francisco within the space of not more than one-fifth of a second. For such is the utmost twinkling required for the passage of an electric spark through 3,000 miles of wire.

To accomplish this the telegraph company is obliged to take all other business off the wires each day just before 12 o'clock. Three minutes and a half before noon arrives operators in all parts of the country cease sending or receiving messages and devote their attention to attaching wires in such a manner as to establish unbroken connection from Washington with points in every section of the Union to which the lines extend their ramifications. A dozen seconds before the time bell is to strike a few warning ticks come flashing along, and at the very moment when the sun passes over the seventy-fifth meridian a current gives a single throb from Maine to Florida and from the Atlantic to the Pacific, informing an expectant nation of the time of day.

Now the way in which the telegraph company makes money by distributing the time in this manner is by selling it to people all over the United States who have clocks and find it of importance to keep them right. In this manner it keeps corrected by electricity to absolute solar time no less than 7,000 clocks in the city of New York alone. All that the company is obliged to pay is the cost of maintaining its instruments at the observatory and the wires connecting these instruments with the main office in Washington. But it must be remembered that the cost of stopping telegraphic operations for four minutes in the busiest part of each day throughout the entire country is not inconsiderable.—*Com. Gazette, Pittsburg.*

A MACHINE FOR THREADING AND CUTTING OFF PIPES, ETC.

The illustration represents a recently perfected machine, patented by Mr. Arthur W. Cash, which presents many novel features, and is designed to perform accurately and rapidly a wide range of work in threading and cutting off pipe, shafting, etc., while being simple and durable in its parts, and capable of being operated either by hand or power. The machine proper is supported upon a suitable pedestal, and the base has a hollow upward projection in which is a cavity for the reception of oil or other lubricant, and in which is journaled a hollow tool-carrying shaft, with a change speed gearing, the arrangement permitting of the use of a large quantity of oil, so that the gears may run submerged, and be tightly inclosed, to prevent the entrance of dirt or chips. Motion is communicated by means of a transversely arranged primary shaft having on one end a pulley and on the other end a crank. Upon the forward end of the hollow shaft is a circular head in which the dies and cutting-off tools are mounted, the dies being secured upon die blocks radially movable in the head, while the face of the head bears gauge marks by which the standard marks upon the dies may be set. Behind each of the die blocks is a short shaft journaled in the head, each shaft having an eccentric wrist projecting into the die block, and its inner end carrying a small gear. Toothed sections in the periphery of a ring mesh with these gears, and immediately at the rear of the ring is a hand wheel, which, with the ring, gear, and eccentrically placed wrists, imparts radial movement to the die blocks and dies in the head, to project the dies inward to operate upon the end of a pipe or bar, or withdraw them, leaving the center of the hollow shaft clear for new work.



A PIPE-THREADING AND CUTTING-OFF MACHINE.

The cutting-off mechanism consists of small carriages arranged opposite each other in the head between the die blocks, each of the carriages having an adjustable tool, and being moved inward or outward as desired by feeding screws. The threading dies and cutting-off tools are so arranged as to prevent any possible damage to work by their simultaneous operation, the dies when at work projecting into the field of the cutting tools, and the latter, when in operative position, preventing the engagement of the dies with the work.

A vise, whose base is adapted to slide upon ways on the end of the bed, as shown at the right in the engraving, presents the work to the tools, so the work is rigidly held against all movement for the cutting-off operation, or is held against rotation and given an inward feeding movement for the operation of the screw-cutting dies. The power is applied directly at the rear of the vise jaws, so that the end thrust of the screw is borne by the standard instead of by any part of the machine out of line with the jaws. In cutting threads, the work is forced into engagement with the dies by means of a transversely extending lever fulcrumed on the vise base, and is there held until the threading is completed, when, instead of reversing the machine or imparting movement to the work, the latter may be disengaged by turning the hand wheel operating the die blocks. In the work of cutting off, after adjustment, the tools are operated into initial engagement, when a movable trip engages the arms of small feed wheels, feeding the cutting tools inward intermittently at either of two speeds until the pipe is severed. The hollow tool-carrying shaft being open at both ends, pipe of any length may be operated upon.

This machine is manufactured by the Armstrong Manufacturing Co., Bridgeport, Conn.

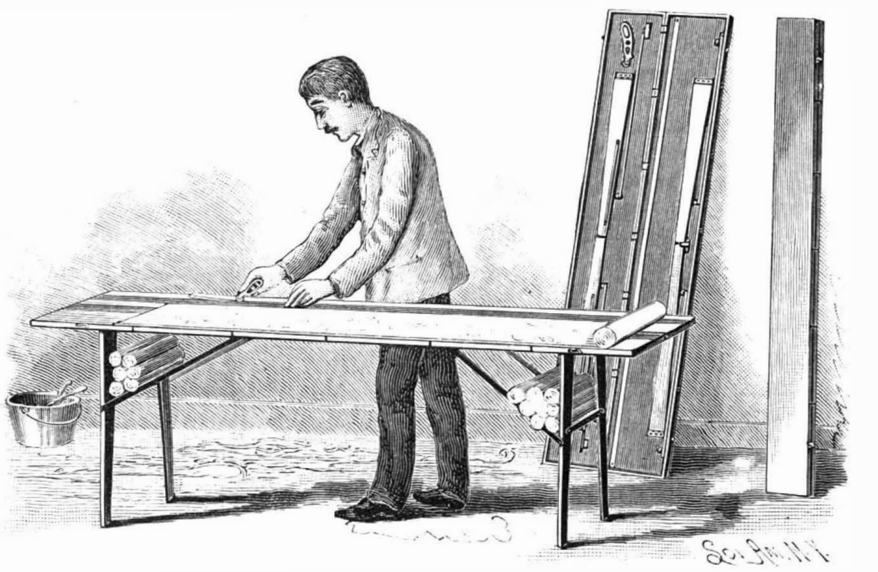
Luminous Paint.

We have before spoken of the new German manufacture of luminous paint, by which oil or water colors, shining by night with white, red, blue or yellow, according to the variety desired, can be sold at retail at about a dollar a pound, while the price of the Balmain paint, as made and sold in England, is about nine dollars a pound.

On account of its high price, the Balmain paint has never come into extensive use. It was evidently good, but, as the expense of covering a wall with it amounted to about two dollars a square yard, it was impracticable to use it, as the manufacturers recommended, for painting the interiors of cellars, railway tunnels and other dark places, and it came at last to be used only for painting match boxes, key holes and small objects. The German luminous paint, which is sold in Berlin by Fretzdorf & Mayer, Steinmetzstrasse 15, and in Dresden by Gustav Schatte & Co., costs only about seventeen cents for enough to cover a square yard of surface, so that it would be really possible to paint a room with it, without ruinous expense. At present, a good deal of it is used in painting crucifixes and images of saints, which find a ready sale in Germany, and are exported in large quantities.—*Amer. Architect.*

A FOLDING TABLE FOR PAPER HANGERS.

The table shown in the illustration folds in a manner somewhat similar to a checker board, the legs folding completely within the covers formed by the top of the table, the under side of which has downwardly projecting strips on each section to constitute a hollow box when folded, with means for retaining in position a ruler and rotary cutting tool. On the upper surface of the table are two longitudinally extending metallic plates, of zinc or other soft metal, constituting suitable surfaces on which to cut the paper. The four legs are separately hinged to fold, two within each section, as shown in one of the views, and when the table is set up, each leg is held in place by a small metallic rod, hinged at one end to the bottom of the table at one side, and engaging an eye on the leg. The legs are further stiffened by a cross rod joining the end legs, such rod being pivoted on one leg and having a hook engaging an eye or pin on the other leg. The cutting implement consists of a handle, in the lower end of which is journaled a rotary cutting wheel, the handle being so formed that the cutter may be readily buttoned upon a stud on the under side of the table when the latter is folded. The cutting wheel is of hard metal, such as tempered steel, and well adapted to cut wet paper. The table is preferably made about six feet long by two feet wide, the figure at the right in the picture showing it folded so as to be conveniently carried under the arm.

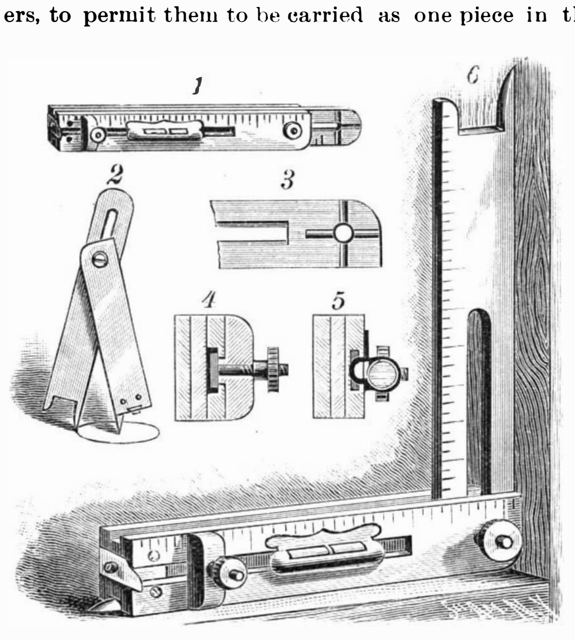


BOYSEN'S FOLDING TABLE FOR PAPER HANGERS.

For further information relative to this invention address the patentee, Mr. George H. Boysen, No. 4312 Frankford Avenue, Philadelphia, Pa.

SEVERAL USEFUL TOOLS IN ONE.

The illustration represents a compact combination of correlative tools for the use of wood and iron workers, to permit them to be carried as one piece in the pocket. It is a combined rule, square, bevel, scribe gauge, spirit level and dividers. Fig. 1 is a side view of the device folded, Fig. 2 shows its principal portions employed as dividers, Fig. 3 is an inner view of a joint section, Figs. 4 and 5 represent transverse sections of the device when folded, and Fig. 6 shows it in the form of a square. The stock has two equal sized strips or side pieces held spaced apart at one end by a slightly tapered block, a slotted blade piece being held intermediate of the main side pieces and a screw bolt and nut being adapted to clamp these pieces, while a longitudinal rib on the inner surface of one side piece of the stock mates a transverse groove in the blade piece near one end, to hold the blade at right angles to the stock when the rib and groove are interlocked. As shown in Fig. 6, the square is available for testing and measuring objects on its inner surface, but by extending the blade in the opposite direction a square will be formed with graduations on its outer edge.



WOODRUFF'S COMBINATION IMPLEMENT.

For further information relative to this invention address Mr. R. E. Woodruff, the patentee, No. 192 Hannah Street, W., Hamilton, Ontario, Canada.

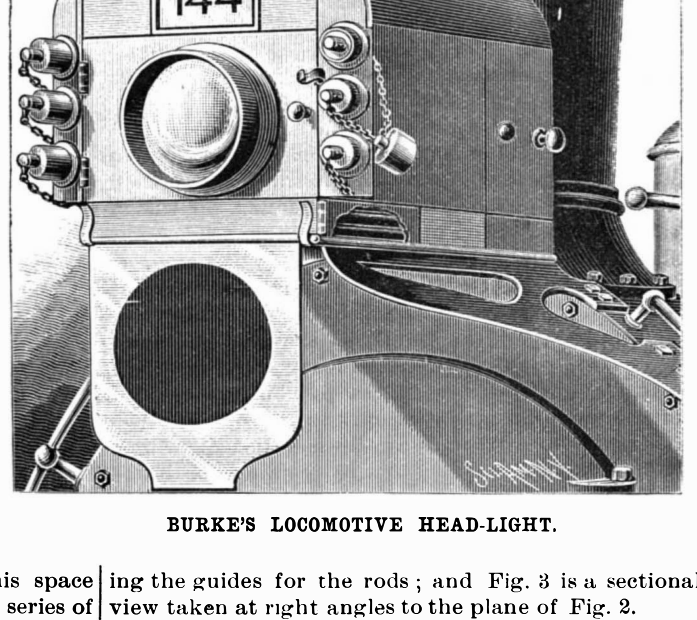
The Benefit of Coffee.

Dr. I. N. Love, of St. Louis, in a paper on this subject, said that his experience for five or six years past had been strongly in favor of taking a cup of strong, black coffee, without cream or sugar, between two glasses of hot water, before rising every morning—at least an hour before breakfast. The various secretions were stimulated, the nervous force was aroused, an hour later a hearty meal was enjoyed, and the day's labor was begun favorably, no matter how the duties of the day and night preceding might have drawn upon the system. Another cup at four in the afternoon was sufficient to sustain the energies for many hours. In this way the full effect was secured. If, along with this the proper diet was taken at the proper times—and the ideal diet for those who make large draughts upon their nervous systems and expected to have them honored was hot milk—and at least eight hours of sleep were taken out of every twenty-four, one's capacity for work would be almost unlimited.

AN IMPROVED HEAD-LIGHT FOR LOCOMOTIVES.

The illustration represents a locomotive head-light in which the lamp may be filled and regulated from the outside, or an incandescent light may be used instead of an oil lamp, while the construction provides for the display of various signals without the use of separate lamps, a receptacle being also provided in which day signals may be kept in position for ready use. A slide adapted to support the reflector is mounted on a suitable bracket upon the bottom of the lantern casing proper, as shown in the small view. The reflector is made of two separate sections, divided vertically and transversely at the point where the lamp chimney passes up, the front section having side flanges with movable slides connected to that section by springs, while the rear end of one of the slides is connected by a hinge to the rear section of the reflector. The other slide has a handle for its convenient manipulation, the construction being such that the rear section may be swung aside when desired, or drawn rearwardly against the tension of the springs to admit the lamp chimney between the front and rear sections of the reflector, as shown. The oil reservoir has a downwardly sloping upper side, to facilitate the adjustment of the lamp under the rear end of the reflector, and a filling tube, whose outer end is upwardly curved and provided with a cap, extends from the reservoir through the casing. The burner has a wick raiser or regulator, a shaft from which extends through the rear wall of the casing, where it terminates in a hand wheel, the construction being such as to prevent the wick from being jarred down into the wick tube by the jolting of the locomotive. One side of the casing has a sliding door at its rear end, with a glass-covered opening through which the interior may be inspected, while one of the sides of the rear section of the reflector has a similar opening, whereby the flame of the lamp may be observed while it is being adjusted. When an electric incandescent light is to be used, its bulb has a bail to which is attached a wire passing through a staple on the inner side of the casing, the bulb being projected into a reflecting funnel adapted to fit in the front section of the reflector, the rear section of which is then swung to one side. In the front of the casing, at each side, are screw-threaded flanges or collars, at the outer ends of which variously colored glasses are suitably mounted, to give such signals as may be required, suitable caps or covers being provided for readily covering or exposing the light as desired. A supplemental bottom forms a space below the lantern casing proper, and the side walls of this space have longitudinal cleats adapted to support a series of day signals, the several signal plates carried here having at their rear ends laterally extending lugs, which, when the plates are drawn forward, will engage catches at the front end of the casing, by which the day signal will be suspended, as shown in the large view.

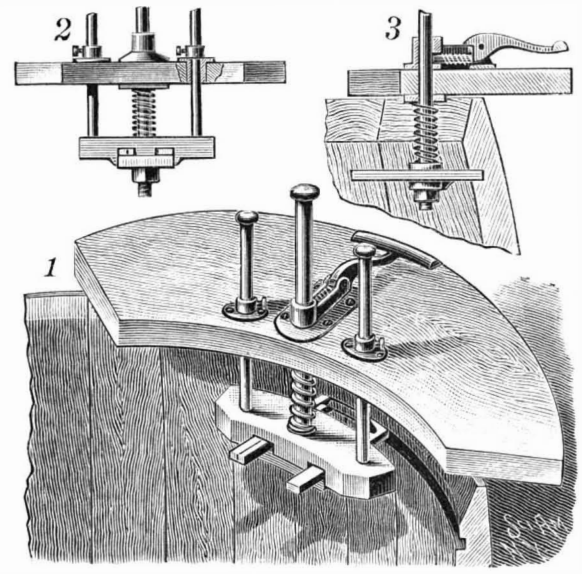
The construction is designed to be economical, and to give all the day or night signals which may be required without the use of extra lamps. For further information relative to this invention, address the patentee, Mr. William J. Burke, Box 900, Seattle, Washington.



BURKE'S LOCOMOTIVE HEAD-LIGHT.

IMPROVED CROZE.

The improved adjustable croze shown in the annexed engraving is constructed so that it may be instantly adjusted to barrels of different sizes. The large segmental plate which rides upon the rim of the barrel supports the other parts. Below the large segmental plate is supported a smaller plate of similar form, by three rods extending through the upper plate. The lower plate carries two cutters and a plow for forming the croze. The central rod extends through a guide attached to the upper plate, and to the upper and lower plates upon this rod is placed a spiral spring. The guide of the central rod is furnished with ears in which is pivoted a lever which bears upon the end of a short rod arranged parallel with the segmental plate, and provided with a retractile spring for drawing it away from the central rod when the lever is released.



ADJUSTABLE CROZE.

The cutters are placed in any desired position, and the central rod is clamped by pressing the outer end of the lever as the upper segmental plate is grasped to operate the tool. By this means the cutters may be instantly clamped so as to cut a groove for the barrel head at any desired distance from the rim of the barrel. The side rods are furnished with collars having set screws by means of which the downward movement of the lower plate is limited.

The perspective view, Fig. 1, shows the application of the croze to a barrel; Fig. 2 is a sectional view showing the guides for the rods; and Fig. 3 is a sectional view taken at right angles to the plane of Fig. 2.

This invention has been patented by Messrs. William Kampfe and Joseph Nagengast, Bayonne, New Jersey.

Science Senses.

In the past ten or fifteen years there has grown up a need for special training of the senses, in order to use properly scientific instruments, not in study or in any way applying to it, but as necessary adjuncts of business communication in every-day life.

First on the list will come the telephone. Most persons using one for the first time find themselves absolutely *hors de combat,* unable to recognize a familiar voice, and are only conscious of the most helpless hearing-deafness. After a short training the ear and mind adjust themselves with wonderful nicety to the new duty required of them, and learn to recognize a voice as unerringly as though talking face to face with the individual who is, perhaps, miles away.

Following closely in the wake of the telephone, which may be looked upon as the pioneer of the inventions which will later rely upon the auditory nerves or hearing for their use, is the graphophone, a marvelous little machine, whose fitness for the work it has to do is so wonderful that, were it not explained on purely scientific principles of natural laws, man would think the inventor of it in league with the "Buyer of Souls."

It records sounds by the vibrations of the air acting on a steel stylus, which is so placed that it cuts or traces fine lines on a cylinder of rubber coated with wax.

These lines are of varying depth, according to the force of the sound waves.

The vibrations or sounds are reproduced by the aforementioned cylinder being revolved under a small stylus to which is attached a pair of tiny ear trumpets which are so adjusted that they transmit with absolute fidelity every sound wave to the ear.

It is impossible to predict the boundary line of scientific discoveries, and the uses to which man may put them in the near future.

But to follow out the idea of the trained senses, take the vision, how the microscopist with his little instrument is every day opening new vistas.

It is only the supreme intellect of the human mind which renders what may be called the brute senses of man of use to him, because when untrained they rank far below the senses of the animal, though in the latter they are not so evenly balanced as in man.

The eagle and condor have wonderful vision. Of these birds it is said that the former can face with an unflinching eye the sun when shining with full noontide glory, and of the latter Prescott in his "Conquest of Mexico" says, "The sight of the condor of the Andes is almost beyond belief. When a horse or mule drops by the roadside, scarcely a moment passes before one or more of these huge birds may be seen hovering over the unfortunate animal, proving plainly that they are guided by sight alone."

The sense of smell in animals is perhaps found in the highest perfection known in the well-bred bloodhound. This animal will follow a trail hours after the man or animal has passed, and never lose it, even though it had been passed over by hundreds.

The sense of touch possessed by the clumsy-looking elephant is most wonderful. The tough-looking hide which covers him would never make one think he could lay claim to the sense of touch in any degree of perfection.

Man supplements what he lacks by using his knowledge of the laws of nature. Thus with the aid of the microscope and telescope he can compete with the eagle and condor.

Up to the present time he has not invented any instrument which will aid in distinguishing odors, but passing over that, he has covered nearly the entire range embraced by the five senses—sight, taste, touch, smell and hearing.

When we speak of trained senses, we do not for an instant mean to imply that the man of the present age is better equipped by nature with the senses than his ancestors were, but that by the aid of scientific instruments he has supplemented the use of these senses to an almost supernatural extent. However, beyond a certain point he cannot go, as it is only in his power to use intelligently the things that be, not to create.

Every invention of man thus far has only consisted in some new or perhaps forgotten application of a law of nature, and is not in any way dependent on the inventor personally, save in his ability to make his knowledge of practical use to the majority of mankind.

The man of science is the idol of the present age. His daring and success in the field of invention have blinded the eyes of the people to the fact that there can be a limit to his power, and make them lose sight of the reality that he is only a pupil in the school of nature, where the doors are open to all.

It is not probable that any special benefit will be done mankind physically by this training, for it does not demand any abnormal conditions. It is simply a better understanding of our physical capability of using our senses by intelligently applying them to obtain a result known to be as certain as the law, "water seeks its own level."

There is a vast change in the tendency of the inventors of the present age, and this generation specially. Force is guided rather than controlled, and the result is that machinery has become more delicate and often more simple, but requiring by that very fact a more highly educated mind to operate it than did the crude machinery of the early inventors, where muscle was as much needed as knowledge. All that is changed. Ignorance is now often death-dealing, particularly when electricity is the motive power or where chemical compounds are used.

Every day adds to the necessity for a practical working knowledge of the numerous inventions which are now found in daily use in all civilized countries the world over.

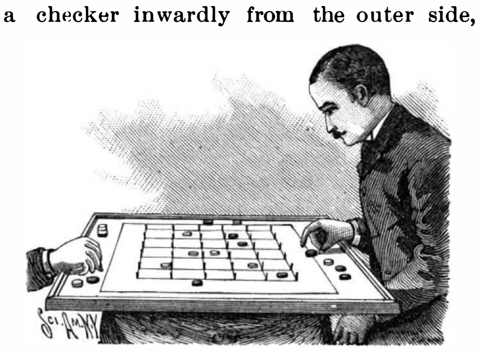
No one who has ever read "John Halifax, Gentleman," can forget the masterly description given of the personal antagonism felt by the working men to the machinery which was placed in his mill by the hero.

In their blindness they could not realize that mental labor placed them on a higher plane than manual labor, and that machinery at its best can only supply muscle, not mind, and that they were being given, by the very machinery which they were bent upon destroying, their one chance to be something more than mere machines themselves.

It is to be hoped as the world grows older it grows wiser, and that we are being carried to a "Golden Age" on the wheels of the inventions of the twentieth century. DORSEY BARTON.

A SIMPLE FORM OF GAME.

The game board shown in the picture is not unlike a checker board, but it has a surrounding marginal flange, and upon the lines or at the intersecting points of the squares are upwardly projecting pins, so arranged that they will appear in aligning parallel rows. The game has been patented by Rev. Norbury W. Thornton, of Geneseo, Ill., and is styled by the inventor "The Race Problem." The players have twelve white checkers for one side and twelve black checkers for the other side, and the first play is made by snapping a checker inwardly from the outer side, with



THORNTON'S GAME.

the intent to lodge the piece behind one of the central pins, out of reach of a similar play from an opponent. It is the effort of each player, then, in this manner, to place as many of his pieces centrally on the board as possible, knocking outside of the area of the pegs or pins the pieces of his opponent. Two hundred points are designed to constitute a game, the highest count being for the central space, and the count diminishing proportionately toward the margin, all men outside of the pegs or pins counting ten for the opposite side.

The Borate of Soda in the Treatment of Epilepsy

was first proposed by Charles F. Folsom, of Boston, in 1881. Gowers reported four cases treated with the remedy, three of which were entirely cured.

Lately, *El Siglo Medico* reports, Senor Dijond has tried the remedy in 25 old cases in which the *bromides* had been employed without any real benefit. The duration of the treatment with the borate of soda was from four to seven months, the doses of the remedy varied from one to six grammes a day.

One case was completely cured, and all the others, except six, were much improved.

The experiments heretofore made prove that the remedy can diminish the frequency of the epileptic seizures in a very large number of cases which are not influenced favorably by the bromides.

The borate of soda may be given in doses of six grammes, daily, without any risk to the patient, but it is necessary to begin with one or two grammes a day and gradually increase the dose.

The following formula is recommended :

Sodæ borat. pulv.	1 to 6 grammes.
Syr. aurant. carb.	" 30 "
Aquæ destillat.	" 100 "

M. S.—To be taken in two doses, one in the morning and one in the evening.

For doses larger than four grammes, one gramme of glycerine should be added for each gramme of borate in excess of four.

For the prolonged use of the remedy, Senor Dijond recommends the following :

Sodæ borat. pulv.	grammes 10
Glycerini puræ.	" 4
Syr. aurant. carb.	" 94

M. S.—To be taken in spoonful doses. An ordinary spoonful contains two grammes of the borate of soda.

An Automatic Photographist.

According to *The Electrical World*, the application of the nickel in the slot principle to automatic photographing is about to be accomplished. Mr. Matthew J. Steffens obtained a patent on the device December 11, 1888, and has others pending. The mechanism is operated by two separate and distinct electrical circuits. In securing a photograph, a quarter of a dollar is passed through a slot and the visitor takes the desired position, and then gives a slight pull to the cord in front of the case, when the shelter in front of the lens of the camera is automatically drawn aside, and the flashing of some magnesium in a brass pan, fired by the heating to incandescence of a platinum wire, throws the necessary lights, and a perfect negative is secured on a plate having a white background and made of flexible celluloid. This part of the operation, the writer says, requires but two seconds of time. The visitor then waits while the plate is rolled over two small wheels and gripped by two rubber tapes, which carry it through the developing, fixing and washing fluids, and finally pass it through a second aperture or slot, a perfected photograph. The entire movement of the second operation is controlled by an electric motor operated by a current from a primary battery. The necessary chemicals are each supplied separately from an airtight reservoir, and the flow regulated by a dial apparatus to correspond with the temperature of the atmosphere and the strength of the chemicals.

The machine will be placed in drug stores and other places where "slot" machines are found to pay. It is said that this device can be used in securing instantaneous photographs of criminals while they are being booked, and that it will be used by railway companies to prevent improper use of mileage tickets, though the success of this latter application is doubtful. The model of the machine was made by the Franklin Electric Company, of Chicago, for the inventor, who is a well known artist of Chicago.

To verify the statement of our valued contemporary before publishing it, we sent the article to the electric company who constructed the apparatus, to know if it worked satisfactorily, to which they reply as follows :

Chicago, Oct. 30, 1890.

Messrs. MUNN & CO., Editors SCIENTIFIC AMERICAN.

Gentlemen : In reply to yours of Oct. 24, the automatic photographic machine was built by our company for Mr. M. J. Steffens, the inventor.

Regarding the merit of the invention, would say that the first machine, as described in inclosed article, was a success, but the inventor was not satisfied, as the mechanism was too complicated.

Our company has built four different models for the inventor, and the last one, which has just been completed, is very simple and promises to be a great success.

As the patents are not yet issued, we cannot give you a description of the machine, but it seems to work perfectly, day or night. At night or in dark places a magnesium light is used. The inventor controls the magnesium or any artificial light used in automatic photographic machines, granted in former patent.

Pictures taken in daylight are very good, and the way the inventor uses magnesium light now seems as good as can ever be expected. Any one can work the machine, as there are no cords to pull or buttons to press, as the coin does it all. The time required to complete the picture is two and one half minutes. It is delivered with a metallic medallion-shaped frame, and the entire work is done by the aid of electricity. We will request the inventor to furnish you with the details of the machine, as we know him to be an admirer of the SCIENTIFIC AMERICAN.

As perhaps you are aware, Mr. Steffens is also the inventor of an aerial camera which caused some notice a couple of years since, and we are now constructing for him an improvement on the same. Trials with a small machine proved very successful, showing a distance of twenty-two miles distinctly.

The camera is attached to a small balloon, is regulated and the exposing done from the ground by electricity.

The negatives are made on celluloid films, and several hundred can be taken at each ascension.

Yours respectfully,

FRANKLIN ELECTRIC COMPANY,

Per P. R. H.

St. Clair Tunnel Celebration.

The St. Clair river tunnel commission is making great preparations for a celebration on the opening of the tunnel. It is proposed to serve the banquet in the hole itself upon a table 1,000 feet long, 500 feet on each side of the international boundary, the chairman to sit exactly on the line. On the Canadian side of him will be the President of the United States, and on the American side the Governor-General of Canada, these two flanked by a string of ministers of state and notables from both countries. The tunnel will be brilliantly illuminated by electricity and the decorations will be intrusted to a corps of special artists.

Correspondence.

Ingrowing Toe Nails.

To the Editor of the Scientific American:

About ten years ago I cured ingrowing nails on both of my big toes in the following manner, which can be done by any one who has the least amount of ingenuity and patience. First thoroughly clean the parts, and then pack in front of the nail cotton or lint as hard as may be borne. This will remain with comfort for three or four days, then remove and in front of the pellet will be found a hardened mass of flesh; scrape this away and repack, continuing the operation until the corner of the nail has grown out and is beyond the soft tissues of the toe. Of course easy-fitting shoes or boots should be worn during the treatment and ever after.

JOHN G. HARPER, D.D.S.

The Sudbury, Ontario, Nickel Belt.

To the Editor of the Scientific American:

The Sudbury Nickel Belt, as it is called, was discovered about six years ago, during the construction of the Canadian Pacific Railway through the district. But for two or three years afterward very little development work was done, as it was supposed at first that the ore deposits were copper. The range so far as explored is over fifty miles long, and from three to ten miles wide, running from Lake Wahnapilae to the Spanish River, in a northeast and southwest course. The mineral occurs in great beds that sometimes rise into tremendous hills and ridges above the surface, and covered with gosan or decomposed ore. The range culminates into literal mountains of mineral in the townships of Denison, Graham, and Drury, along the Algoma or Soo branch of the railway. Gold, silver, copper, and platinum have also been found in various places on the range, and even cassiterite or tin ore. The copper and nickel are nearly always found together, and generally in about the same proportion in the ore, but in the famous vermilion mine in the township of Denison the whole five different minerals specified above occur.

There are already five mines being worked on an extensive scale, and a great many other locations being opened up. Three smelters or blast furnaces are in constant operation, reducing the ore into matte. Six tons of ore on an average make one ton of matte, which carries from twenty to thirty per cent of nickel and an equal amount of copper. It is shipped in this state, mostly to Swansea, Wales. The ore is first roasted in large heaps in the open air, to burn the sulphur out of it.

A great number of capitalists have been here this season examining the nickel mines and deposits of the range, and from present appearances this is going to become one of the chief mining centers of the world before long.

R. J. SWANSON.

Nickel City, Ont.

Physical Development of Children.

Dr. Axel Key, of Stockholm, read a very interesting paper before the recent Medical Congress, Berlin, on the development of puberty and its relation to morbid phenomena among school children. In Denmark and Sweden it has been the custom for many years to weigh and measure the school children every year. Out of 15,000 boys and 3,000 girls the results were as follows: "In the seventh or eighth year of life boys grow considerably in height and in weight, after which a delay sets in which reaches its maximum in the tenth year and lasts till the fourteenth year, when a considerable acceleration of growth suddenly sets in. This acceleration lasts till the end of the seventeenth year. Its maximum is in the fifteenth year. The acceleration is at first in height and later on in weight, gaining its maximum in the latter in the sixteenth year. At the end of the nineteenth year bodily development of youth seems to end. In girls the course of development is quite different. The decrease in growth after the eighth year is not so great as in boys and yields in the twelfth year to a rapid increase in height. The acceleration in the increase in weight comes later, but outstrips it in the fourteenth year. In the seventeenth or eighteenth year the increase is but slight. The increase in weight, however, sinks to zero almost in the twentieth year, when the growth in women may be regarded as ended." A remarkable thing, as pointed out by Dr. Key, is that boys grow faster than girls in weight and height till the eleventh year, then more slowly till the sixteenth, and then faster again. With slight variation these relations obtain all over Sweden and Denmark. In Italy and the United States of America the period of puberty in girls ends at least a year earlier. "In the spring and summer the child grows more in height, while in the autumn and winter it increases more in weight." "How is it now with the health of school children during the development of puberty? It was found that 40 per cent of the 15,000 boys in the high schools in Sweden were ill; that 14 per cent suffer from habitual headache, 13 per cent from chlorosis." "We ought," he concluded, "to adapt our demands on the youthful organism to its strength and power of resistance during the various phases of development, to promote the health and vigorous bodily development of youth better than we do now. I therefore indorse, from the bottom of my heart, the words which Johnn Petter Frank, the father of school hygiene, uttered a hundred years ago: 'Spare their fiber still, spare the forces of their minds, do not waste the energies of the future man in the child.'"

The Street Railway Convention.

The popularity of the electric motor was well attested at the recent meeting of the American Street Railway Association at Buffalo. In the West, especially, where it has been in continuous use for a considerable period, comparative estimates of economy between horse and electrical traction have, it would appear, demonstrated the superiority of the latter, at least from the shareholders' standpoint. Practical men, used to estimating costs and familiar with both systems of traction, gave their views, recounted their successes, and disappointments while looking for perfect service, and though not able to devise the means of remedying defects, furnished clear and comprehensible descriptions of their needs. From these it would appear that the repair shop for electric motors has taken the place of the horse hospital, which, in horse railway service, makes so formidable an item in the expense account.

How to keep the electric motor out of the repair shop. That appears to be the most important question now agitating the field. The station and overhead trolley wires, with a minimum of expert attention, may be kept in repair, but unseen and often unexplained causes serve to stop the wheels of the motors. Now it is a lame armature, again a burnt field magnet, a fused connection, or broken gear. These are everyday occurrences—so the railway men say. Not yet has the mechanic's cunning sufficed to make certain the working of the axle gear and intermediate shaft gear, shaft pinion, and armature pinion. Then there are the boxes or bearings of the axle, intermediate shaft and armature. Trouble here is trouble all over. There is a large and general demand for gear and pinions which won't break, for gear that will be reasonably durable and at the same time noiseless.

One of the speakers at the recent meeting said that cast iron might do for axle gear, which is large and of slow movement, but only steel was fit for intermediate shaft pinions. He was firm in the belief that steel does better than bronze in such employment, lasts longer, besides being less expensive. His experience with electric motors had taught him that to overcome the noise it is necessary either to have the gear covered and running in oil or to have the gear of wood or the pinion of rawhide. The large gear on the axle and intermediate shaft, if made with wooden teeth and used with steel pinions, he had found to run noiselessly and to last longer. Those who gave extra care to making the keys in all gear and pinions tight and self-retaining would, he believed, find themselves amply rewarded. The shaft boxes and bearing, experience had taught him, must be made of some compound metal that will not wear out too fast, for but little wear on the armature bearing will allow the armature to scrape on the pole pieces of the motor.

Continuing, he said: "The electrical parts of the motor in which we are most interested are the armature, field magnets and the controlling switch or rheostat. The armature of an electric motor is its most wonderful and interesting as well as its most expensive and troublesome part. A street car is the most overloaded vehicle known to mankind. It may run a week with a light load, and then suddenly receive enough passengers to load fairly well three or four ordinary cars; the driver may forget to oil either the car or motor, he may reverse the motor accidentally or purposely to avoid an accident; these and many other causes require of an armature more work than it is capable of. Hence a burn-out. On the other hand, the armature itself may be at fault. An armature such as we use to-day consists of a shaft surrounded by a metallic core. Around this core is wound the best insulated wire, each coil terminating at the same end of the armature and being attached there by means of solder or screws to the bars of the commutator. The shaft of the armature will in a few years become worn by its bearings, and it would be well to have bushings or sleeves placed around the shaft at those points, which sleeves can be removed. As there is no wear to the core, and as the commutator can be renewed when worn down, which ought not to occur in less than two or three years, an armature should then have as long a life as one could desire, were it not for the coils of wire. Where these coils cross around the head of the armature they chafe on each other and destroy their insulation. Where they end in the commutator they loosen. By an excessive load or careless driver they burn out. It may be possible to repair the armature by rewinding one coil or by refastening the loose ends, and even when a deep coil is burnt the total rewinding with new wire should not cost but forty or fifty dollars. Could we but prepare for the burn-outs by having the car on some side track near the repair shop, where it would not interfere with our running time or cause a hindering of cars, we would not feel so aggravated; but it happens invariably at the time we need every car most urgently. We can watch our gear and bearings, and when worn they may be replaced at our convenience, or at night, but an armature gives out without warning. It is on this account that those systems advocating but one motor to a car must give us positive assurance of *no burn-outs*, for were it not for the double motor now so generally in use we would see crippled cars being *towed* into the shop, greatly to our discomfiture. In the matter of minor details, such as cables, terminals, trolleys, and gearing, the electric manufacturers have made the greatest improvements during the past eighteen months; but so far as we can obtain information based on actual facts, there has been but little improvement in the armatures. The Edison company has recently announced a new armature, but we have been unable to learn what results it may show."

According to the testimony given, the rheostat used in one system, and for which so much has been promised, is not infrequently burnt out and often injured by rain leaking through the platform. A principal claim made for this rheostat is that together with resistance coils the cars are started more easily and the motor is less liable to burn out, an excess of current being avoided. As to the first claim, it would seem to be fairly true, but the evidence of practice does not support the second claim. Indeed, it was openly asserted that motors using a rheostat require more current than those which do not use it—from 15 to 20 per cent more. Perhaps this is due quite as much to a difference in the winding in the armature or fields as to the use of a rheostat. As to the advisability of using the rheostat there seems to be some doubt, it being suggested to collect evidence of the actual number of burn-outs. An owner of an extensive plant operated under fairly favorable conditions testified that his fuel cost about $1 per car per diem, and repairs $1.50 per car per diem. "If," said he, "we can save 10 per cent each day on fuel by giving up the rheostat, we do not want to do it at the expense of adding 25 per cent to our repair account—already much too large."

An example of the approximate cost of repairs is thus given; the figures referring to four 30 horse power Sprague cars for the six months ending October 1, 1890, each car making 90 miles a day, the grade being 1,900 feet of 9 to 9¾ per cent, one 300 feet of 5 per cent, one 300 feet of 8 per cent.

MECHANICAL.

3 bronze intermediate pinions, at $14	$42.00
3 steel " " " 9	27.00
8 steel armature " " 7	56.00
4 intermediate gears, at $11	44.00
2 main gears (axle), at $16	32.00
6 axle brasses, at $4.50	27.00
8 shaft bearings, at $4.50	36.00
12 armature bearings at $2.75	32.00
Total	$296.00

ELECTRICAL.

180 carbon brushes, at 10 cents	$18.00
6 trolley wheels, at $1.25	7.50
3 field magnets, at $20	60.00
6 armatures repaired, at $35	210.00
	$295.50
For labor:	
2 motor repair men, at $50 per month	$600.00
Total	$1,191.50

Average per diem per car, $1.62.

There are other minor repairs that would increase this about 20 cents a day.

Fuel, sawdust, and slabs, $1.30.

A statement which went unchallenged, and may, therefore, be taken to be approximately correct, was that the cost of operations of a 10 car road is the same by electricity or horses; that, when the number of the cars is above 10, a road may be more economically operated by electricity. When the number reaches 50 cars and upward, the cable is the most reliable and economic.

An interesting feature of the Buffalo meeting was the favorable testimony elicited for storage battery traction. The facts given by W. J. Carruthers-Wain, president of the Tramways Institute of Great Britain and Ireland, concerning the Birmingham road, will do much to prove that, even at its present stage of imperfection, the storage battery may be run with economy as a motor. The cars he operates are constructed to carry 50 passengers, 24 inside and 26 outside. They are 26 feet long, 6·3 feet broad. Each car with its motor and batteries weighs 9 tons. The average takings of the road are $1,250 a week, as against $750 for horses. The cars will run seventy hours—the road has grade of 1 in 19—from one charging. They cost little comparatively for repairs, and when intelligently handled give little trouble.

"Sundown Doctors."

This is the appellation said to be applied in the city of Washington to a class of practitioners who are clerks in the government offices, and who have taken a medical degree with a view to practicing after the hours of their official work are over.

AUXILIARY RIFLE BARREL FOR GUNS.

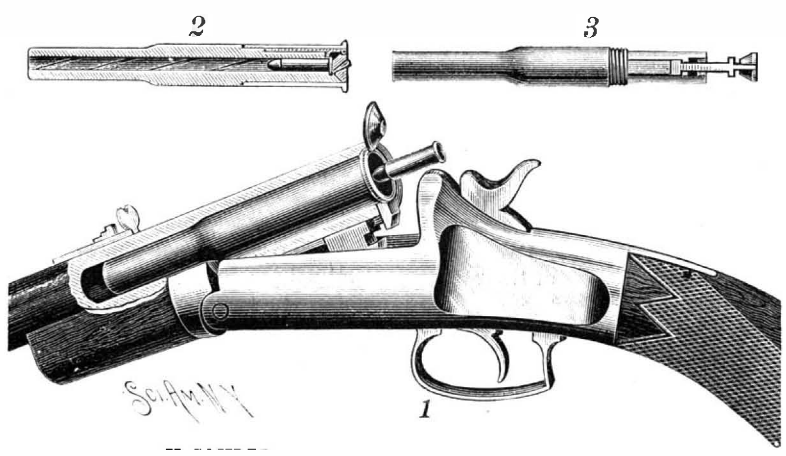
We give an engraving of an improvement in guns which permits of converting any ordinary center-fire, breech-loading rifle into a weapon of smaller bore. This invention consists in an auxiliary rifle barrel adapted to be inserted in the ordinary gun barrel in the place of a cartridge, the auxiliary barrel being rifled and furnished with a hinged breech cap for confining the smaller cartridge.

The rear end of the auxiliary barrel is reduced in diameter, and grooved longitudinally to receive the cartridge extractor to which the breech cap is pivoted, and the breech cap and the cartridge extractor are inclosed in a sleeve screwed on the auxiliary barrel. The breech cap is provided, in the present case, with an oblique firing pin, but where a center-fire cartridge is used, the pin goes straight through the cap. The sleeve on the auxiliary barrel is provided with a flange corresponding to the rim of the shell of the larger cartridge, and the auxiliary barrel is arranged to be withdrawn from the gun barrel by the usual cartridge extractor.

The cartridge in the auxiliary barrel is fired in the same manner as the ordinary cartridge, and the empty shell is removed by drawing out the cartridge extractor, the hinged breech-cap being used as a handle for the purpose.

One advantage claimed for this improvement is that a sportsman may use the auxiliary barrel and the smaller cartridges for small game, and without any change or adjustment may withdraw the auxiliary barrel and use the gun for the larger shot.

This invention has been patented by Mr. James W. McCandless, of Florence, Colorado.



McCANDLESS' AUXILIARY RIFLE BARREL.

NOTES ON QUARRYING.

BY WM. L. SAUNDERS.

I have recently spent a little time at some quarries in the South, notably the extensive granite quarries of Brandywine Granite Co., on the Brandywine Creek, Wilmington, Del., and the soapstone quarries of the Albemarle Soapstone Co., North Garden, Va. It is a conspicuous fact that the quarries in the South are better equipped with machinery and with modern appliances than those in the North. Any one who has made a tour of inspection through the extensive marble quarries of Vermont, going there with a view of entering the quarry business and of learning something, will find that, while he will be interested and instructed in what he sees, yet, if he goes through the Georgia quarries, stopping *en route* at the Tuckahoe deposits, Tuckahoe, N. Y., he will realize that his Vermont instruction was largely in the line of ancient history. This applies not only to the quarrying, but to the finishing of the marble. Hand channeling is still pursued in some of the Vermont quarries, though this is rare. Hand drilling may be seen in many of the quarries. The derricks have the old iron rod guys. Boom lifting is unknown there, and in some of the deeper quarries a block of marble is lifted several times and by several derricks before it is landed on the bank. But the backwardness of Vermont quarrymen in modern methods of handling stone is nowhere shown so conspicuously as in the old stone boats which are drawn about the yards and mills by the ponderous ox.

The quarries in the South are of more recent origin than those in the North; hence those who operate them seek and apply all modern improvements. In some cases which have come under my observation the equipments have not been applied only because the foreman was from New England, and sailed in the old "stone boat" so long that it was difficult to get him out of the rut.

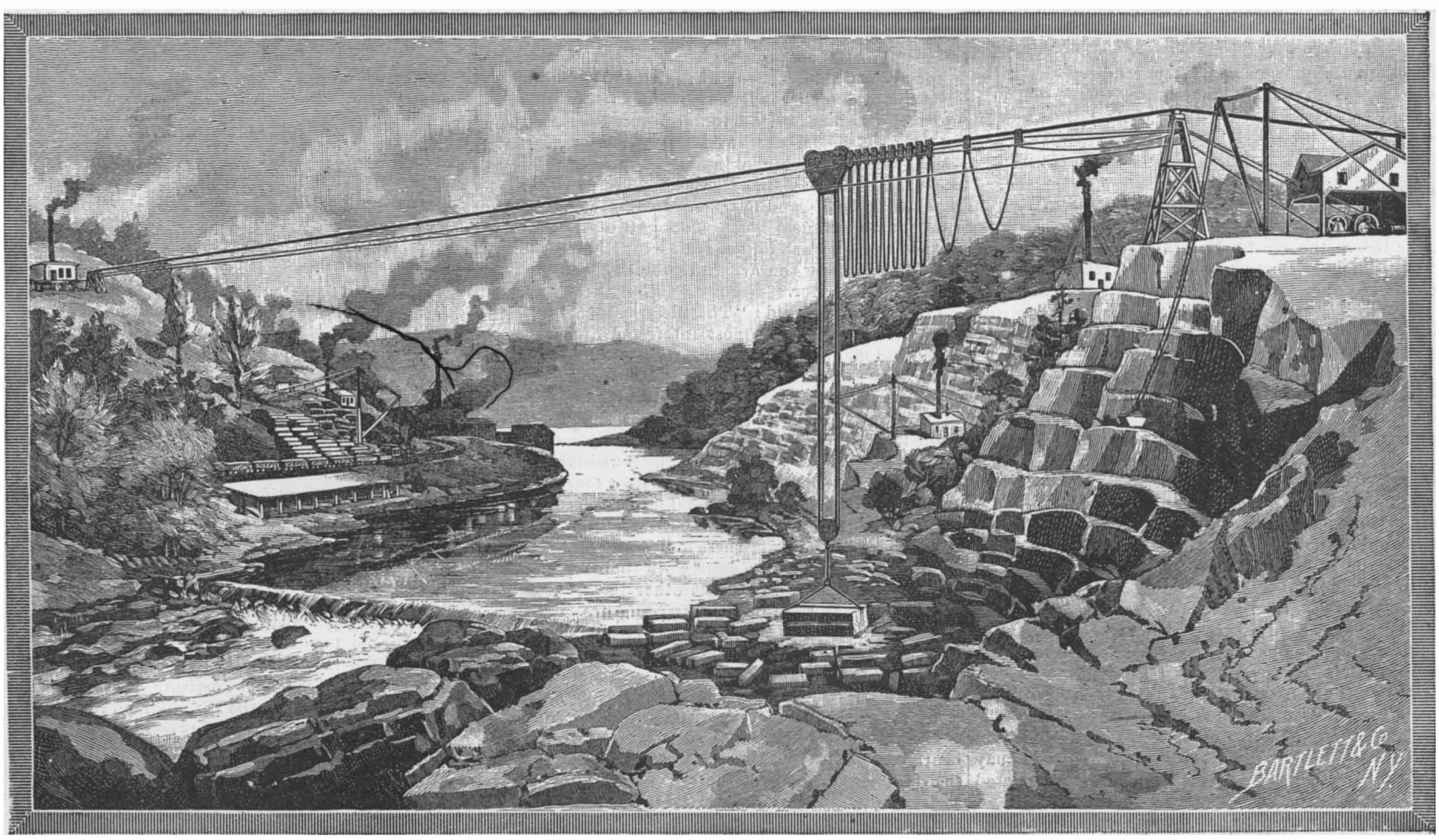
I visited the Brandywine quarries with a gentleman from Brazil, who came here for the purpose of studying American methods of granite quarrying. He had been through New England, and had been told that the best way to split up large blocks of granite into small ones was to do it by hand, just as he had been doing it in Brazil. This statement was made by men of large experience in the New England quarries, and it made such an impression upon him that it was necessary, in order to offset it, to show him actual results. We found at the Brandywine quarries a machine at work splitting up blocks of granite readily, economically, and satisfactorily. We got at the exact facts in regard to it, which showed, beyond dispute, that the work can be done cheaper by machinery than by hand.

But the most interesting feature of the Wilmington quarries is the wire cable hoisting and conveying apparatus, an illustration of which is herewith shown. There are three of these conveyers reaching from one side of the river to the other, a distance of about 1,200 feet. The stone is quarried from both sides of the river, though at present operations are going on only on one side. Blocks of granite weighing ten tons are lifted by one man operating a hoisting engine, and by him transferred across the river and deposited upon a car. The conveyer is a steel wire rope two inches in diameter, anchored and resting upon "A" frame braces at each end. The cable may be either level or inclined as desired. The carriage travels either way on the cable, being propelled by means of an endless rope operated by a hoisting engine. This endless rope is sustained by carriers to prevent its sagging. By means of this rope the carriage may be stopped and held at any point on the cable while the stone is being hoisted or lowered. The hoisting and conveying may be carried on either separately or together, in the latter case effecting a great saving in time.

The reach of one of these conveyers extends at an angle of 45 degrees from the cable, by means of which stone can be dragged until it is suspended. Sometimes it is advisable to use a snatch block, by means of which the distance of drag may be considerably extended.

While at the Brandywine quarries I saw a man lift a large mass of stone from the quarry, run it across the river on the conveyer and deposit it on a bank there. There was no one on the other side of the river, so that the stone was dislodged by the man running the hoisting engine. The courteous and intelligent secretary of the Brandywine Co., Mr. H. M. Barksdale, informed me that this stone was of a size and kind for which they had no orders at present, and they were simply depositing it on the other side of the river in order to get it out of the way, intending to bring it back again and use it later on. Here was a means by which a quarryman could, with but little expense, deposit his different grades of stone in different dumps on a line with each other, keeping his yard clear and free from all unused stone, and having a means by which he can pick up a block at any time that will nearest conform to an order which he has in hand. That the Brandywine quarries are producing stone economically is evident from the fact that they are supplying a large amount of finished stone for use on the Sodom dam, on the New York aqueduct.

This same system of hoisting and conveying, somewhat modified, is in use by the contractors who are building the Sodom dam, and I have also seen it in the slate quarries at Monson, Me. There are many quarries in Vermont that might apply it with profit to themselves.—*Stone.*



WIRE CABLE HOISTING AND CONVEYING APPARATUS AT QUARRIES OF THE BRANDYWINE GRANITE CO., WILMINGTON, DEL.

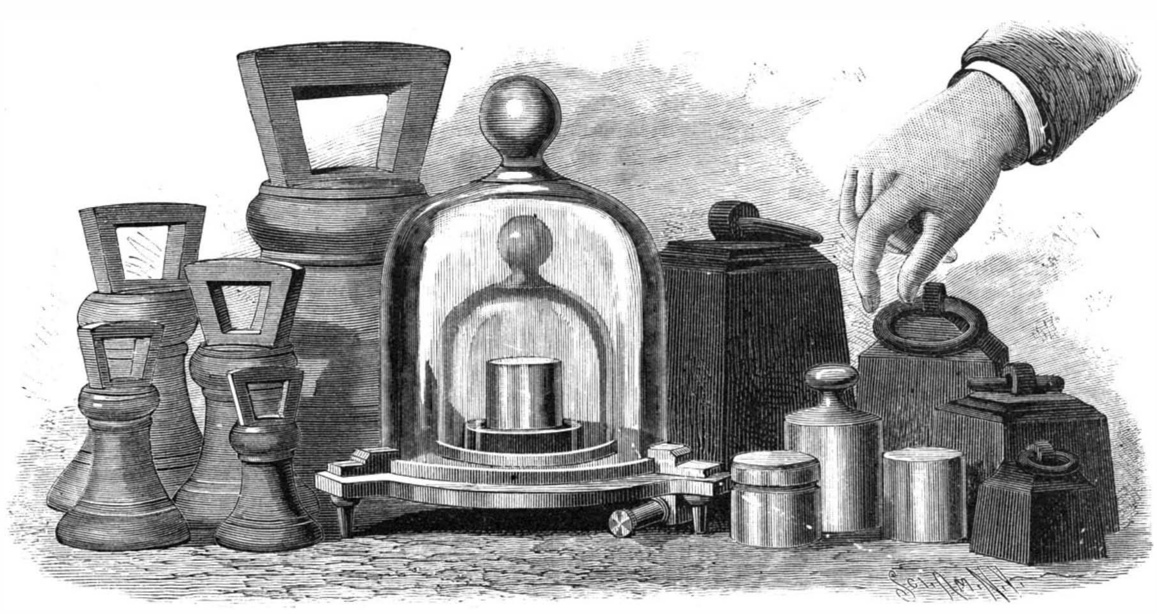
AT the shops of the St. Charles Car Company there have recently been built four gorgeous museum cars. The gilding alone cost over $3,000, and the cost of the entire coaches is about $24,000. The idea is to run the train into a town and have the exhibition on the cars. One car contains the electric light plant which is to light the museum train.

THE UNITED STATES COLLECTION OF STANDARD WEIGHTS AND MEASURES.

We illustrate in the present issue the collection of standard weights and measures, preserved at Washington, in the fireproof building of the United States Coast and Geodetic Survey. Many of these are now of purely historical interest, the more recent ones only being accepted as absolute standards.

The smaller cut is devoted to the collection of weights. Among these are shown the cruder forms of weights originally used in this country as standards. In the foreground of the picture, to the right of the glass case, are three which are of special interest. One which is nearly cylindrical in shape, with a slight groove around its upper portion, is known as the gilt pound, and represents the British unit of weight. Immediately back of it is the "committee kilogramme." It can be recognized by the knob on top. It is a brass weight, and is one of a number made at the same time under the charge of the French committee who, near the end of the last century, established the original metric standards of measurement. It was procured for Mr. F. R. Hassler by M. J. G. Tralles, early in the present century. M. Tralles certifies it to have been of true weight within one-half milligramme at the furthest. It is a cylinder 53 millimeters in diameter, the height being equal to the diameter. To the top of the knob it is 78 millimeters in height. The knob is 25 millimeters in diameter. The original committee had a peculiar stamp, which consisted of an ellipse supposed to represent a meridian section of the earth divided by two diameters into quadrants, three of which quadrants were shaded, while the figures 10,000,000 were marked within the unshaded quadrant near its outer perimeter. This, of course, is an allusion to the base of the metric system. This stamp is impressed upon the bottom of the kilogramme we have described. The metal of which it is composed seems to have been porous, as it shows minute holes and considerable oxidation. It is, of course, of great historical interest.

The third of this group of weights, a simple cylinder in shape, is known as the Arago platinum kilogramme. The Hon. Albert Gallatin when United States minister at Paris in 1821 procured this standard, together with the eminent physicist's certificate stating its exact relation to the French standard, the "Kilogramme des Archives." The letter accompanying it is dated Sept. 7, 1821.



COLLECTION OF STANDARD GOVERNMENT WEIGHTS.

It has had a number of comparisons. In 1879 it was compared with the British platinum kilogramme and its specific gravity was determined by Chaney. In June, 1884, it was taken to Paris and compared with the international standard, at the International Bureau of Weights and Measures, and was returned to the United States in the personal care of Dr. Thomas Craig, reaching the office on Sept. 3, 1884.

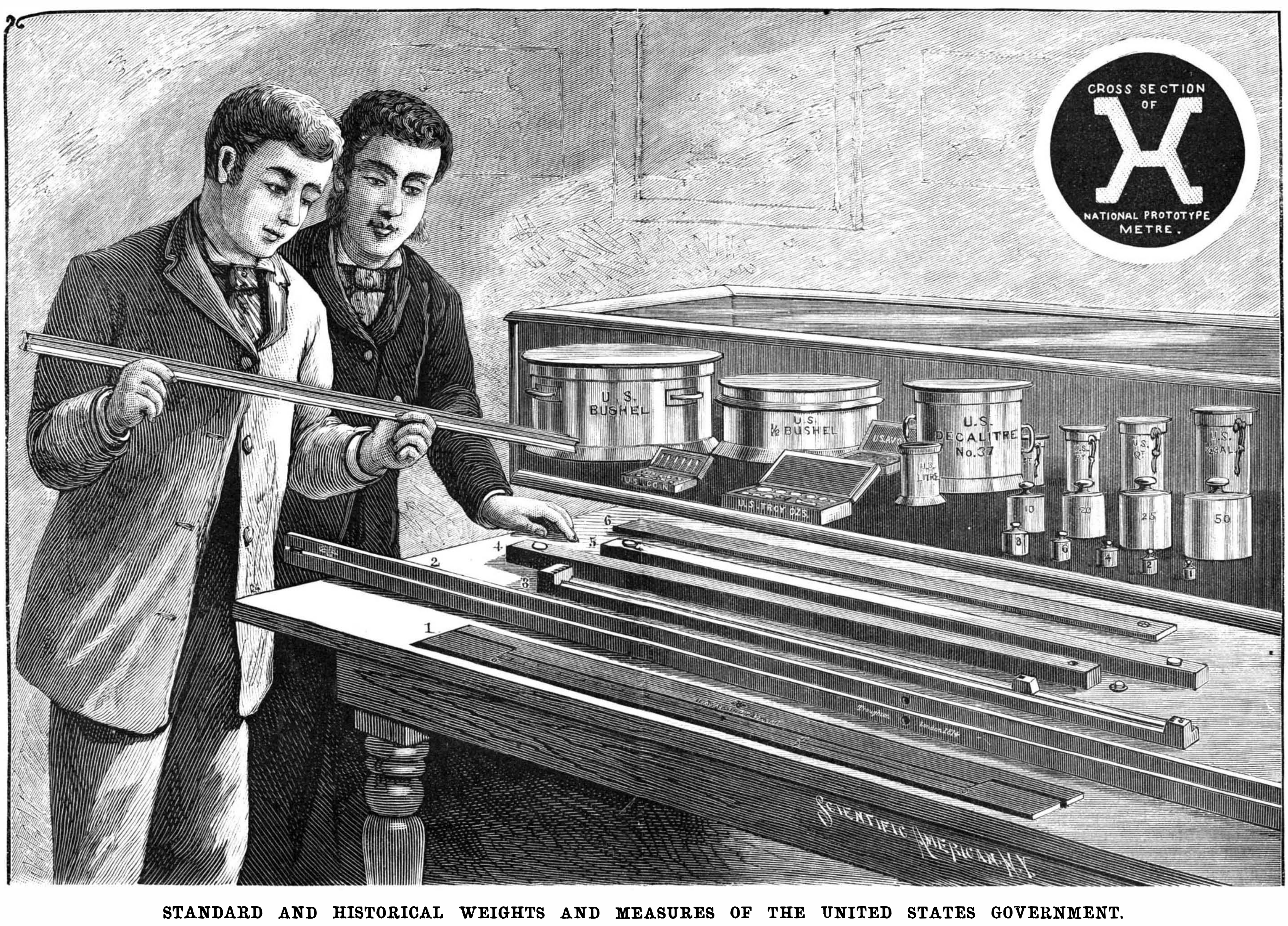
Under the glass shade in the center of the drawing is a representation of the national prototype kilogramme, No. 20. This represents a kilogramme constructed by the co-operation of the principal governments of the world. In 1870, under invitation of the French government, delegates of the leading nations met in Paris and were organized into an international commission for the construction of a new meter, as an international standard of length. Professors Henry and Hilgard acted as the United States delegates to this convention.

In 1872 a treaty was signed at Paris establishing the International Bureau of Weights and Measures, which is under the administrative direction of delegates from the countries concerned. A large number of learned men were employed to study the methods to carry out practically the theoretical requirements of the case. Eventually standard meters and standard kilogrammes were constructed, which are termed international prototypes, and reproductions were distributed by lot to the different governments in September, 1889. The reproductions are termed national prototypes and are numbered consecutively.

For the preservation of the original international prototypes a subterranean vault is provided at Paris. This secures them against accident and against any sudden or great change in temperature which might conceivably bring about a change in the molecular structure of the metal. In this vault they are kept under lock and key, three different keys being required to open the vault. The keys are in charge of three separate individuals. The American national prototypes will be preserved in Washington, with similar precautions to those just described in the case of the originals in Paris.

The prototype kilogrammes are made of a standard alloy of 90 per cent platinum and 10 per cent iridium, with a tolerance of 2 per cent either in excess or deficiency. The form of the kilogramme is a cylinder with slightly rounded edges, its height being equal to its diameter; its weight is referred to vacuo and it is practically an exact copy of the international prototype.

The national prototype meter, No. 27, is of the same alloy as that composing the prototype kilogramme just described. Its cross section, adapted to secure it against flexure and to allow of rapid accommodation to changing temperature, is shown in the corner of the



STANDARD AND HISTORICAL WEIGHTS AND MEASURES OF THE UNITED STATES GOVERNMENT.

large cut. The observers in the same cut are supposed to be holding a copy of it in their hands. The cross section is shown of the true size. The bar is 1·02 m. long. The meter is defined by lines drawn upon the upper surface of the portion connecting the side elements of the bar. It will be observed that the cross section is not symmetrical, and that the surface just referred to corresponds with the medial plane of the mass of metal.

Upon the table in the large cut are shown other standards of measurement. Fig. 1 is the U. S. standard yard, such as is supplied by the Federal government to the different States. It is an end measure and consists of the yard proper and of a template which nests into it so as to protect its terminal planes from deterioration.

Immediately back of it, and represented by Fig. 2, is what is known as the Troughton scale, made by a London maker, bearing his name and dated London, 1814. It was made for the use of the Coast Survey of the United States. It is a brass bar with an inlaid silver scale. It is 86 inches long, 2½ inches wide, ½ inch thick. The strip of silver which runs down its center is inlaid flush with the brass and is a little more than one-tenth of an inch wide. Two parallel lines are ruled upon the silver longitudinally, being about one-tenth of an inch apart. Starting at about 3·2 inches from one end of the bar, the graduations begin, and the silver strip is divided for its length into tenths of inches. As a standard of reference the interval between the 27th and 63d inches of that scale has been adopted. This portion, it is found, corresponds to the mean of the whole scale, and has been compared with other standards.

Fig. 3 in the same cut shows the yard and ell bed plate made by Thomas Jones, instrument maker for the Honorable Board of Ordnance, etc., of Great Britain. This bears the impression of the exchequer stamp. Two grooves run longitudinally along the bar, with stops at the ends. The length between one pair of stops is supposed to be a yard, and that between the other pair an ell. It was made in the early part of the present century.

Figs. 4 and 5 represent copies of the British standard yard, and are designated respectively bronze No. 11 and iron No. 57. They were presented to the United States by the British government through G. B. Airy, Esq., Astronomer Royal. They were received in 1856, and are accompanied by statements as to their length, coefficients of expansion and directions for use. Each bar is 1 inch square in section and 38 inches long. At each end are wells ½ inch in diameter and sunk ½ inch below the surface, thus reaching the medial plane. In the bottom of each well is a gold pin one-tenth of an inch in diameter, upon which are drawn three transverse and two longitudinal lines. The yard is given by the distance from the center of one middle transverse line in one well to the corresponding point in the other well. Covers are provided for the wells in order to protect them from dust. The alloy used in the bronze bar consists of 16 parts of copper, 2½ parts of tin and 1 part of zinc. The iron yard is made of Low Moor iron. They are inscribed in each case with the temperature at which they are supposed to be standard, 61·79° Fah. for the bronze bar, 62·58° Fah. for the iron bar.

Fig. 6 represents a committee meter standardized by the French committee in 1799. It is one of fifteen similar bars made at that time, and is an interesting reminiscence of the famous determination of the meter. It was presented to F. R. Hassler, already alluded to, who later became the first superintendent of the Coast Survey, by J. G. Tralles, of the Helvetic Republic. Mr. Hassler brought it to this country in 1805. It is a plain iron bar 29 mm. wide and 9 mm. thick. It is an end measure, the entire cross sections of the bar being designed for abutting surfaces. It is stamped with three dots as a designating mark, and also possesses the three-quarter shaded ellipse already described as the mark of the original committee.

In the glass case back of the linear standards are shown various standards of measure and weight, which speak for themselves. It is sufficient to say that the measures of capacity are fitted with glass plate covers. In use these are to be slid over the accurately ground edge of the metal so as to secure absolute fullness A set of United States coin weights, troy ounces, etc., are also preserved here. All these standards are kept in a room which is dark and dustless. The two prototype standards will be preserved in specially constructed safes.

Our thanks for the facilities afforded in the preparation of this article are especially due to Dr. T. C. Mendenhall, superintendent of the United States Coast and Geodetic Survey.

The ceremony of breaking the seals of the prototype meter No. 27 and kilogramme No. 20 took place at the White House in the presence of President Harrison, Secretary Blaine, Secretary Windom and a distinguished company, on January 2, 1890. The departments were represented by the following, who signed a memorial to the effect that they had witnessed the ceremony: Prof. T. C. Mendenhall, Superintendent United States Coast and Geodetic Survey; Prof. S. P. Langley, Secretary Smithsonian Institution; R. M. Hunt, Esq., President of American Institute of Architects; Col. Thos. L. Casey, Chief of Engineers U. S. Army; Capt. R. L. Phythian, U. S. Navy, Superintendent U. S. Naval Observatory; Wm. Henry Trescot, Esq., U. S. Delegate to International Congress of Three Americas; Oberlin Smith, Esq., President American Society of Mechanical Engineers, and many others, including members of Congress, professors, members of the Coast and Geodetic Survey, and members of engineering and scientific societies.

As Others See Us.

The visit of the Iron and Steel Institute to this country and the criticisms made by some of its members upon the management of our iron and steel works have called renewed attention to the differences between American and foreign engineering practice to which we have frequently referred.

The point of difference which is most observable is the rapidity with which all operations are conducted in America as compared with foreign iron and steel works. Here both men and machinery seem to be strained to the utmost in the effort to turn out the largest possible number of tons in a day. The energy of the American owners is concentrated on the saving in two great factors in production, the number of men employed and time. Wages are high, therefore the labor must be dispensed with wherever possible and automatic machinery substituted. Time is still more valuable, and none of it must be wasted. It appears to be as criminal for a machine or a furnace to stand idle as for a man.

In consequence of this hurry and rush in American works, other economies are apt to be neglected, and such neglect seemed to elicit criticisms from our English visitors which overbalanced their approbation of our skill in other directions. The waste of material was especially objected to. The amount of our crop ends in steel mills would not be allowed in any English works. Our steam engines were thought to be decidedly wasteful of steam, and our boilers not durable nor safe. Fuel economy, except in a few of the best managed works, seems a matter of no importance, and no attempt is made to save by-products of coke ovens as in Europe.

No doubt many of these criticisms are well deserved. Until the introduction of natural gas in Pittsburg, the waste of coal in the iron works of that city was simply scandalous. Scarcely a steam boiler could be found in the city in which the temperature of the chimney gases was not from 800° to 1,000° Fahr., and the puddling and heating furnaces were, with but few exceptions, of the old styles which seem to be especially calculated to utilize only five per cent of the fuel burned in them, and to waste the other 95 per cent. Steam engines also, except in recently built or remodeled works, were of the old fashioned, slow stroke, throttling and non-condensing styles, the retention of which in these days of compound condensing engines is a disgrace. Since natural gas has been introduced, its great abundance and cheapness have even served to retard improvements in steam plants in iron and steel works, but now that there are signs of the exhaustion or curtailment of the supply, and the price charged for its use is raised, there will likely be more attention paid to its economy.

In each of the cities which the foreign guests visited the daily papers showed their usual enterprise in printing interviews with some of the visitors, in which they were made to express unbounded astonishment and approbation of what they had witnessed in America; but to one who had traveled with them from place to place it was noticeable that the expressions of commendation were generally offset by criticisms. What nature had given to America, such as her climate, her scenery, her greatness of distances, her mineral and agricultural wealth, her natural gas, were extolled as they should be; but what man had done was usually but faintly praised. "Very clever! but I think our way is quite as good, if not better," was a common verdict. The large daily product of our blast furnaces was attributed to our excellent ores, and not to skill in management, and the short life of the furnaces was contrasted with the long life of foreign furnaces, to our detriment. Our rapid rail rolling was thought not to produce as good rails, and to be obtained with an excessive wear and tear of mill and driving of the men, which would not be submitted to in England. Even our newest machine works, such as the Westinghouse Air Brake Works, at Wilmerding, were found fault with as not being sufficiently lighted.

Much of the criticism was undoubtedly due to the mental habit of the Englishman—he is usually on the lookout for something to find fault with; but it is well for us to be criticised occasionally, as it may reveal to us shortcomings which we had not before suspected, and lead to improvements in our practices, even if it should necessitate the copying of some foreign ideas and methods. While we do lead the world in the output of our blast furnaces, converters and rail mills, there are many lessons we may yet learn from our transatlantic rivals.

It is a conspicuous fact, which was frequently brought out in addresses made at the meetings, that America is indebted to England for nearly all our iron and steel metallurgical methods, and while our iron and steel engineers have taken precedence in developing the mechanical engineering features of the works, they have not been noted as originators of new metallurgical processes. The names of Huntsman, Cort, Neilson, Heath, Mushet, Bessemer, Siemens and Thomas stand pre-eminent as English metallurgical discoverers, and no list of Americans can be named who can by any stretch of the imagination be compared with these as great originators and discoverers in iron and steel metallurgy. The one American engineer who by common consent is accorded the first rank among American steel works engineers, the late A. L. Holley, was strictly a mechanical engineer, and his work was in improving the methods of handling Bessemer steel and not in the process of making it. Of those who have brought our practice to its present stage of progress, such as the brothers Fritz, the two Joneses, Forsyth, Fry, and Hunt, there is not one who has contributed to it any original metallurgical idea. They have merely as mechanical engineers adopted the leading ideas of the foreign metallurgists, invented and improved machinery for carrying out these ideas, and have shown extraordinary skill as organizers of men and machinery in such a way as to turn out vast amounts of product.

The time has now come, however, when metallurgical discoveries ought to be as much expected here as in Europe. Many of our establishments are now on a solid basis, possessing great wealth, mechanical equipment which ought to be good enough for ten or twenty years without further improvement, excellent organization of both technical and managing staff, and finely equipped chemical laboratories. Some of these works should be able not only to develop students and discoverers, but to provide them with sufficient money for metallurgical experiments.

Another path in which the American works can now develop is in that of reducing wastes of fuel and of material. Now that mechanical engineering has developed machinery for handling to such an extent that the smallest possible amount of manual labor is required, the engineers might be allowed to take a rest in this direction and devote themselves to perfecting the steam boilers and engines and furnaces, with a view to saving fuel. The question of coking our poorer coals should be studied, and methods adopted of saving the valuable products now thrown away in the waste gases. The waste in crop ends, in scaling, in fluxing, etc., should also be studied, and remedied.

If the owners of our larger works would pay some attention to these questions, it would result before long in removing the reproach that we are behind Europe in these matters, and might in time enable Americans to point to a list of metallurgists who would rank with the English names above and with the list we already have of mechanical engineers. —*Engineering and Min. Jour.*

Destruction of American Forests.

At a recent meeting in Berlin of the Geographical Society, Chief Forest Master Kessler called attention to the extravagant waste of timber in the United States. Among other interesting details Mr. Kessler spoke of the tremendous destruction of forests in the United States during recent decades of years. Quoting from the tenth census, he stated that in 1880 the 25,708 saw mills then in operation converted $120,000,000 worth of raw timber stock into various kinds of lumber, and he asserted that at the same rate there would be no good-sized timber left in forty years. He spoke of the enormous waste of wood through forest fires, which are the result, for the most part, of carelessness or a desire to clear land for cultivation, and declared that the planting of new forests, which has of late years received some attention in the Eastern States, cannot begin to offset the waste of forests. He said that there is every reason to fear that America will soon be a country impoverished for tree property. Mr. Kessler made the striking comparison that, while the United States had but 11 per cent of its area covered by forests, the empire of Germany has 26 per cent of its entire area so covered. Mr. Kessler said that the reckless destruction of forest trees in America and the indifference manifested by Americans in the restoration of forests is a menace, not alone to the wealth of the nation, but threatens serious deterioration both to climatic conditions and the fertility of the soil.

"IT is not intellectual work that injures the brain," says the London *Hospital*, "but emotional excitement. Most men can stand the severest thought and study of which their brains are capable, and be none the worse for it, for neither thought nor study interferes with the recuperative influence of sleep. It is ambition, anxiety, and disappointment, the hopes and fears, the loves and hates of our lives, that wear out our nervous system and endanger the balance of the brain."

An Official Trial of the Philadelphia.

The new steel cruiser Philadelphia, bearing the blue pennant of Rear Admiral L. A. Kimberly, President of the National Board of Inspection, returned to New York, November 1, from a forty-eight hour trial at sea. The cruiser has been accepted by the government, but this final trial was prescribed in the builders' contract for the purpose of testing her seagoing qualities and discovering any latent weakness in construction. To remedy such possible defects, $35,000 has been retained by the government from the contract price.

The tests were in the main satisfactory, although the board finds room for improvement in numerous minor details, such as storage of boats, fitting of davits, etc. Three gun carriages were disabled. Owing to the foul condition of the cruiser's bottom, no trial of speed over the measured course was made.

It was the admiral's intention to take the vessel to sea immediately, and the necessary orders were issued. Before they could be carried into execution the English steamer Bremerhaven, of Liverpool, which had anchored in defiance of warnings that her berth was too close to allow her to swing clear, was swept by the current against the Philadelphia's port bow. The cable compressors were unlocked and a signal to back quick and hard was rung in the engine room. The engineer threw the throttles open, and the sudden rush of steam in the air-pump engine disabled that delicate and complicated piece of machinery. When the cruiser was backed out of danger an investigation of the damage showed that the bolts of the low-pressure crosshead of the starboard air-pump engine were broken, and that several hours' work was necessary to replace them; so departure was delayed. The forward torpedo port sustained some slight damage, and a strongback was broken. No other damage than this was done.

The broken machinery having been repaired early October 30, the steam capstan was put in motion, the anchor run up, and the cruiser headed seaward. The main ship channel was the route chosen, and while standing through it another mishap befell the Philadelphia, namely, a collision with the coal schooner Gower.

Captain Rodgers, on the bridge of the Philadelphia, set both engines full speed astern. The next moment the schooner struck the Philadelphia on the starboard side and ranged alongside. The latter was perfectly motionless at the moment of contact, and a few seconds later her powerful engines had gathered sternway, and the vessels cleared. The ease with which the magnificent cruiser was handled is the best criterion of her efficiency.

The Philadelphia was uninjured, and having ascertained that the schooner was in no need of assistance, proceeded on her course.

When well clear of the land a strong westerly wind rolled up a choppy sea, with an occasional heavy swell. Through it the cruiser steamed, pitching deeply at times. The roll of the ship was almost imperceptible. Her pitching tendencies are due to the extreme fineness of her lines. Her movements, however, were always steady and easy and without a tendency to throw a person off his feet.

At 10 A. M. the gun divisions were called to quarters. Two rounds at high elevation and extreme train forward and aft were fired from each gun of the main battery. The blast shattered the glass in the skylights and damaged two cutters. The deck and gun platforms stood the severe strain well, but defects developed in the carriages of three six-inch rifles which will probably disable them.

These guns are mounted on central pivot gravity return carriages designed by the Bureau of Ordnance and cast by the Standard Steel Works. Cracks appeared in the piston rod lugs of numbers 3 and 4 starboard and number 4 port. The cracks, known as "heat cracks" to foundrymen, seem to have been calked over and sal ammoniac rubbed in, which rusted the steel effectually and concealed the defects until the shock and strain of firing opened them. The carriages are cast in one piece, and it is difficult to see how the defects can be remedied. New carriages will, in all probability, have to be obtained.

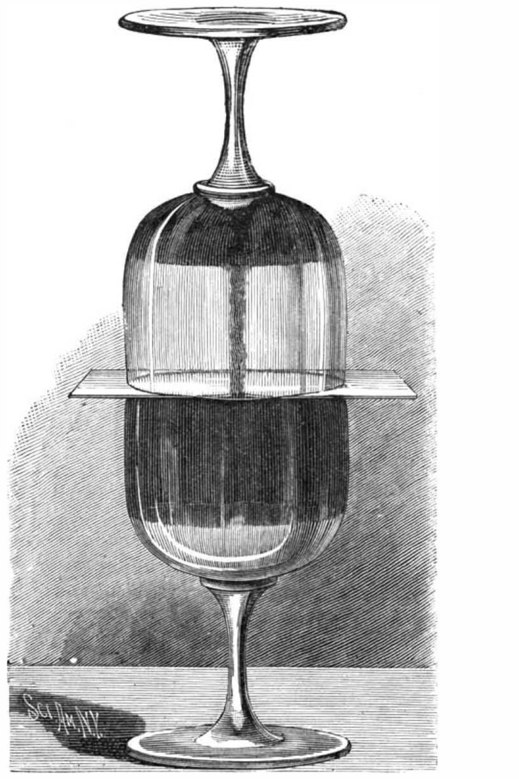
The speed and turning trials took place on the following day. Full steam power was used. With 123 pounds of steam and making ninety-five revolutions to the minute, the cruiser's helm was put hard to starboard. She described a circle in 6 minutes and 3 seconds. Under the same conditions with port helm the time was 5 minutes and 33 seconds. With starboard helm she heeled 3 deg., and with port 8 deg. The reason for this remarkable performance has yet to be explained. The severest test to which the cruiser was subjected was reversing the engine while running full speed. The peculiar type of her engines enabled the vessel to perform the test safely and successfully.

The time from going full speed ahead until headway was checked was 1 minute and 50 seconds. The cruiser's tactical diameter, which is the diameter of the circle in which she can turn, is 2,400 feet. With one propeller backing, the diameter is much less.

Associated with Admiral Kimberly on the Board were Capt. Henry Erben, Commander W. R. Bridgeman, Lieut.-Commander Hemphill, Lieut. L. C. Logan, Chief Engineer Buehler, Naval Constructor Hanscom, and Capt. Porter, of the Marine Corps.

AN INTERESTING EXPERIMENT.

A rather amusing trick can be performed at the dinner table with the aid of two wine glasses and a visiting card. Take two claret glasses of the same size, and fill one with claret quite to the brim, and the other with water. Cover the glass containing the water with the pasteboard card and then ask if any one at the table can transfer the claret into the glass containing the water without pouring out or spilling the liquid in either glass. At first it appears that this is quite impossible, but it may be easily accomplished by inverting the glass containing the water and placing it upon the other glass. After the edges of the two glasses have been brought opposite one another, the card is slipped carefully to one side so as to open a small communication between the two glasses; this done, there immediately begins an exchange of the liquids, and it is observed that the claret is flowing in a gentle stream into the upper glass, the water descending through the small opening and displacing the claret. The claret soon begins to spread out in an even body over the water contained in the upper glass. This process continues until there is a complete interchange of the two liquids. Of course the explanation is simple enough.



GRAVITATION OF LIQUIDS.

The water being a heavier liquid than the claret sinks into the lower glass, and the claret is forced up to fill the displacement of the water. It flows in a steady, clear-cut stream, and the effect as it rises through the water is very fine.

It is remarkable that in this experiment there is no observable intermixture of the liquids. The water contained in the lower glass after the experiment is quite clear and transparent. It is also curious that the water in the upper glass passes the space between the rims of the glasses, and enters the lower glass without any leakage whatever. This, however, is fully explained by the surface tension existing on the liquid at this point.

The card used in this experiment is about the thickness of an ordinary postal card. The experiment is easily performed and is worthy of trying. The upper glass containing the water may lifted and carried about while the card is attached, without holding it on with the hand, thus illustrating in a well-known way the effect of atmospheric pressure.

Aluminium—Grabau's Method.

BY M. JEHON.

This process is based upon the reduction, by sodium, of fluoride of aluminium, produced from the action of sulphate of alumina upon fluor spar and cryolite; but the latter mineral is only employed at the commencement of the operation, it being reproduced in large quantity in an artificial form, as a consequence of the reduction of the fluoride of aluminium, and of a much higher degree of purity than the natural mineral, which always contains spathic iron ore and quartz.

Production of Fluoride of Aluminium.—From ten to thirteen parts of sulphate of alumina, dissolved in water, is mixed with finely divided fluor spar, and heated to 60 deg. Centigrade for several hours, when a partial decomposition of the fluor spar takes place, giving sulphate of lime and aluminium fluoride. By repeating the operation several times, about 66 per cent of the sulphuric acid in the sulphate may be replaced by fluoride. It is more convenient, however, not to push the change beyond 55 per cent. The result is a solution of fluo-sulphate of alumina, $Al_2Fl_4SO_4$, which is filtered, freed from iron by prussiate of potash, and boiled down to the consistency of sirup. This is then mixed with finely ground cryolite to a stiff paste, giving when dried in a lead basin of 150 deg. C. a spongy mass, which is broken into pieces of the size of a walnut, and subjected to a dull red heat in a cast iron vessel in a muffle. This decomposes the remaining sulphate of ammonia, giving as a result pure fluoride of aluminium and sulphate of soda. The latter salt is washed out with boiling water, about 15 per cent of the former also going into the solution. The residue, or 85 per cent of the fluoride in the material treated, is pressed into cakes, dried, and broken up.

Reduction of Fluoride of Aluminium.—The reduction of the fluoride by sodium is performed in a cast iron vessel, whose diameter is equal to its height, lined with cryolite, either rammed, or preferably in the form of bricks, made coherent with a solution of common salt. The fluoride is heated to redness in an iron cylinder with a refractory lining free from iron and silicon, and having a cover at the top and a counterpoised drop bottom. The fluoride does not melt, and is but slightly volatile if kept well covered. The heated charge is dropped into the reducing pot, and immediately afterward an ingot of sodium, heated nearly to its melting point, is added, the whole being covered up by an asbestos cloth. The reaction is very violent; the charge boils, and often flame colored by sodium escapes from beneath the cover. When the proportions of sodium and aluminium fluoride are so chosen that only one-half of the latter is reduced, the remainder combines with the fluoride of sodium formed in the reduction and produces cryolite, which at the end of the operation is found as a well-melted mass, the temperature having risen to a red-white heat, having below it a lump of aluminium, covered with a thin adherent crust of cryolite. The cryolite so produced is much purer than the natural mineral, being perfectly free from iron and silicon, and in consequence the aluminium obtained is often very pure, assaying up to 99·77 per cent, according to the results obtained at the Ecole des Mines, Paris. The sodium used is obtained by a new method, which is only described in general terms, some details not being completely protected. It consists essentially in electrolyzing melted chloride of sodium in a crucible. One electrode is of carbon, and the other an iron wire. The latter plunges into the center of the crucible, and is covered by a bell of porcelain with hollow sides, and a central tubulure connected with the sodium condenser by an iron tube, which carries away the globules of sodium as they form and rise to the surface; the chlorine goes to the carbon electrode. The production of cryolite in this process is rather larger than the amount necessary for reduction, and therefore some surplus will remain for disposal. This may be used by glass makers. As compared with Deville's process, it is said to utilize the sodium more perfectly, from 83 to 90 per cent of the reducing effect being realized, as compared with 76 per cent.—*Annales des Mines.*

Nickel-in-the-Slot Hot Water.

In Paris they now have stands in the streets, a faucet projects from the structure, and under it is a place to set a pail. Near the faucet is a slot, large enough to admit a copper five centime piece, and beside the slot is a button. To use the apparatus, a pail is set in the appropriate place, a five centime piece, equivalent in size and value to the old-fashioned copper cent, is dropped into the slot, and the button is pushed; whereupon a jet of steaming hot water issues from the faucet, and runs until nine quarts have been delivered, when it stops. It may be imagined that in a district thickly settled with poor families, the cost of hot water so obtained is much less than it would be if a fire were kept in the cooking stove to heat it, and the housekeepers who would otherwise have to do their washing with cold water must bless the inventor. The apparatus has, however, another use. It is the custom in Paris for hackmen to keep "bouillottes," or cans of hot water, in their carriages in cold weather, to warm the feet of their patrons, and it is often troublesome and expensive for them to get the water renewed as it cools. By means of the new kiosks, the bouillottes may be replenished with the smallest trouble and expense, to the great benefit of the drivers. The interior of the kiosk is partly occupied by a coil of pipe, within which is a gas burner, for heating water rapidly. The coil communicates with the city water supply, so that the water drawn through is always fresh. The gas is not wasted by being kept burning all the time, but is lighted by the pressing of the button, which also opens the faucet, and the automatic closing of the faucet, and turning off the gas, after the pailful of water has been delivered, are effected by simple devices.

THE wholesale price of whalebone is now $10,000 a ton. A project is on foot to organize whaling expeditions from Australia to the Antarctic seas, where it is believed plenty of whales are to be found. It is an almost untouched whaling ground.

RECENTLY PATENTED INVENTIONS.

Engineering.

STEAM BOILER FEEDER. — Bernard Devlin, Jersey City, N. J. This is an automatic feeder, in which a drum communicating with the steam and water spaces of the boiler has a float valve to cut off the supply of steam from the boiler a piston device being arranged in connection with a valved water supply pipe, the device having a self-opening relief valve, while a steam supply pipe connects the drum with the valve-controlling piston device

Railway Appliances.

CAR COUPLING. — Justin E. Clark, Andover, Mass. In this device the drawhead with a hook or horn, and a peculiar form of bail-like link is pivoted to the drawhead, a yoke-like latch having its ends pivoted to the link, with means for raising the link, which may at any time be thrown out of the coupling position to permit of the drawhead being used as an ordinary link coupler, while the device is operable from the top or the sides of the car.

CAR COUPLING. — Benning Rowell, Badger Mills, Wis. The drawhead is, according to this invention, movable vertically at its forward end, suitably held suspension rods extending down along opposite sides of the drawhead, and their ends being held in a plate on its under side, forming a simple and convenient construction by mean of which the drawhead mouths may be readily set up or down as desired.

VESTIBULE CAR.—John H. Kirkham, Niles, Mich. Combined with the contacting frame of the car are horizontal rods connected with elbow levers, the latter being also connected with buffer springs, with other novel features, whereby the contacting frames of opposing flexible portions are held in constant contact and sudden jars are relieved, the mechanism consisting of few and simple parts that can be readily applied to vestibule cars now in use.

CAR BUFFER. — Seely W. Ashmead, St. Louis, Mo. Combined with buffers adapted to be located as usual at opposite sides of the drawhead are friction rollers or balls held to revolve therein and projected out therefrom, a lubricator communicating with the recesses in which the balls revolve, forming an anti-friction buffer by means of which the wear and grating and grinding of the ordinary buffer are avoided.

CROSSING FOR CABLE RAILWAYS.— James P. Orr, Pittsburg, Pa. According to this invention the two cables crossing each other are combined with a frame adapted to be raised and lowered, with two sets of pulleys arranged thereon, one set supporting one of the cables while the other passes under the other set of pulleys, the arrangement being such as to bring the crossing cables near each other, at the same time preventing the cables from coming in contact.

Mechanical.

TRAVELING CRANE. — Charles Davy, Sheffield, England. This invention is designed to dispense with the tumbler bearings usually employed as supports of the driving shafts, and provide means whereby sliding connection may be maintained with a shaft mounted in ordinary fixed bearings, whether it be the main or transverse driving shafts, which transmit power to the hoisting crib.

LAYING OFF WOOD WORK. — Robert G. Love, Richmond, Va. This invention provides a machine for laying off and marking the stiles of shutters and doors and similar work, preparatory to cutting the mortises therein by a mortising machine, in order to save labor by doing the work more expeditiously than can be done by hand and insure exactness and accuracy in the joiner work, the machine being simple and inexpensive, and operable either by a treadle or by power.

BARREL HOOPING MACHINE. — Frank Glankler, Memphis, Tenn. This invention covers a peculiar construction of the ring or annular platen whereby the hoop is not driven entirely on the barrel, but is allowed to project a little beyond the chine or ends of the staves, so that when the barrel is set away or stored for future use it may be subsequently tightened by driving the hoop all the way on, the cracks which might appear from shrinkage being thereby closed to make a tight barrel.

SHINGLE SHAPING MACHINE.—Daniel W. Williams, Fortuna, Cal. Combined with a vertical chute above a sliding support is a shaper having forwardly projecting arms provided with inner shoulders to move the support from under the chute after the shaper has acted on the shingle, and outer shoulders to return the support on the back stroke, the machine dressing the shingles to the required width and cutting their ends to such form as may be desired.

COUCH ROLL FOR PAPER MACHINES. —Frederick W. Miller and John J. Newman, Elkhart, Ind. This is a suction couch roll, with a shaft having hollow ends adapted to be connected with suction devices, journaled boxes forming the heads of the roller and an annular chamber being formed about the heads, the roll having a porous cover, and ports connecting the annular chamber with the hollow shaft, the roller being also adapted for use as a revolving suction box when placed in any suitable position on a paper machine.

RULING MACHINE ATTACHMENT. — William C. Smith, Brooklyn, N. Y. Transversely rocking forks or links are pivoted to vertical standards at opposite sides of the frame, and a pen beam with arms at its ends is mounted on the forks or links, there being mechanism for reciprocating the pen beam, whereby paper may be tinted or ruled in wave lines at a small cost, producing effects heretofore usually accomplished by lithography.

GRIPPER FOR JOB PRESSES.—George W. Banks, Philadelphia, Pa. This invention provides a means whereby the grippers may be set without the aid of a wrench or similar tool, and so that when they are set they will be retained in a positively fixed position upon the gripper plate and rendered incapable of lateral movement until purposely adjusted.

THEATRICAL APPLIANCE. — Joseph Arthur, New York City. This invention embraces a novel construction and combination of parts employed to produce a scene representing the interior of a saw or planing mill, machinery usual in such establishments appearing in full operation, giving to the scene a most realistic effect.

APPARATUS FOR TREATING COTTON SEED HULLS.—Emil Bohn, Galveston, Texas. By means of this apparatus the hulls are successively ground, screened and stirred, and the ground product directed by an air blast over pocketed chutes, where the coarse, heavy particles are separated from the fine, light particles, the former being discarded and the latter used as paper stock.

TYPE WRITING MACHINE.—Philip P. Wenz, Meadville, Pa. The type wheel of this machine has the letters arranged thereon in combinations such as follow each other in words of common use. By a novel construction and arrangement of parts a single letter or portion of a word may be printed at one operation of the type hammer.

LASTING MACHINE.—Charles E. Goss, Brooklyn, N. Y. In this machine novel means are provided for opening and closing the grippers and for shifting them horizontally, to insure proper stretching of the upper and even fit upon the last preparatory to its being tacked. The tacks are released singly from tubes by the upward movement of the drivers.

Agricultural.

PLOW ATTACHMENT. — Archibald B. De Bruce, Arkansas City, Ark. A plate is arranged a suitable distance forward of and above the mould board, of the same form and general size as the mould board, the under surface of the plate being convexed and not smooth, the design being to compress the soil turned up by the plow, and so that it will all pass easily between the mould board and plate, preventing the soil sticking to the mould board.

PNEUMATIC MILKER. — Julius T. Pomeroy, Edgerton, Wis. A pail with suitably packed cover has connected therewith a simple form of air pump, whereby a partial vacuum may be readily created in the pail, and from the top portion of the pail extend four rubber tubes, provided with nipples and spreaders at their outer ends, the air pump being operated when these nipples are in place for milking, sections of glass in the rubber tubing permitting the operator to see when the milk is flowing freely into the pail, and the milk being thus saved from all contamination.

GRAIN SCOURER. — Peter Provost, Minneapolis, Minn. This invention covers an improvement on a former patented invention of the same inventor, the machine having a cylinder in which three hopper-shaped screens are arranged one above the other, there being a revolving shaft with beater arms in the upper section, a disk with conical lower portion on the shaft in the second screen, and a brush on the shaft in the lower screen, whereby the grain may be thoroughly cleaned and all the dust removed.

Miscellaneous.

NURSING BOTTLE.—James W. McKinnon, New York City. This nursing bottle is so constructed as to avoid all corners, depressions, or cavities in which milk is liable to collect and sour, and to enable the bottle to be thoroughly cleansed with little labor, and to allow of the free circulation of air after such cleansing or while the bottle is not in use.

BUCKLE. — Benjamin H. Day, Jr., West Hoboken, N. J. This is of the class of lever buckles for holding straps and other flexible connections and having a hinged tongue, and its novelty consists in making the tongue of spring metal of corrugated or U shape at or back of its clamping portion, so that it will readily adapt itself to different thicknesses of straps and exert a spring pressure upon them.

PUMP WATER CLOSET. — William D. Baxter, Brooklyn, N. Y. This is a water closet adapted particularly for yachts and marine vessels, but capable of use wherever there is a water supply. Two pumps connected with the closet operate respectively to alternately flush the bowl and draw out the contents of its soil pipe for discharge to a place of deposit, all odors in the meantime being effectually prevented from coming back through the soil pipe.

TABLE. — Edwards A. Reed, Oliver Springs, Tenn. This invention is an improvement in collapsible tables, the construction being such that while the article is stable when in use, it is capable of being compacted to economize space in shipping or stowing away and to permit of its being carried through narrow doors or crooked and cramped passages, and in which the legs are not liable to shift out of place, either when folded or let down.

BURNER. — August F. Reinhold, New York City. This burner is particularly adapted for burning oil for heating or lighting purposes, and is designed to be safe and practically odorless, having a non-conducting, concaved and apertured plate, above the flame, and one or more perforated heat-absorbing and radiating plates held below the top and around the wick tube or flaming point.

RADIATOR.—Arthur J. Brown, Edward Brown, Jr., and Dennis Shay, Bellefonte, Pa. This invention relates to steam and hot water radiators built up in sections of a double tubular circulating and return character, and the radiator has a male and female, steam-packed slip joint between the sections, with a novel construction of the sections and arrangement of their inlets and outlets, affording a most perfect circulation and quickly heating the radiator.

FREEZING BOX FOR ICE MACHINES. —Henry Rea, Jr., and Joshua L. Clark, Pittsburg, Pa. This invention covers a novel construction and arrangement of parts in which a box or tank is subdivided with a series of parallel cells by means of hollow partitions through which a refrigerating liquid is made to circulate, in order to freeze the water into slabs of ice in the intervening cells.

GUN CHARGE INDICATOR.—Gideon K. Pheatt, Toledo, Ohio. According to this invention the gun is provided with pins that will not appear when the barrel is empty, but will project from the upper and lower surface of the gun when the barrel contains a shell, accurately indicating both to the sight and touch whether or not the gun contains a cartridge, and preventing accidents occasioned by the discharge of guns not supposed to be loaded.

EAR TRUMPET. — Frank M. Blodgett, New York City. The receiver or bell of this trumpet is of volute form, its outer curve having a gradually increasing radius, and the inner curve being of appropriate size to fit snugly around the back and over the top of the ear, so that the trumpet stays in place without holding, while the outer surface of the tip which enters the ear has a covering of soft India rubber to protect the ear and in a degree adhere to it to assist in holding the receiver in place.

LEAF TURNER. — James E. Pellow, Sierra City, Cal. This is a music turner with one or more shafts, each carrying an arm adapted to hold the free end of a leaf, while there is a spring-actuated roller for turning the shaft, a locking device to lock it, and means whereby, on pressing a button, the locking device is released, the shaft is turned from right to left, turning the leaf.

SPOON. — Martin L. Schoch, New Berlin, Pa. This spoon has a spring-pressed scraper adapted to move on the spoon bowl, with means for regulating its movement, by means of which all sticky and adhesive substances may be quickly and easily removed from the bowl without the use of an additional instrument.

GATE OPENER AND CLOSER. — Frank W. Kimball, Milford, Ill. A lever bracket-like projection from one side of the gate is connected with cords arranged to run in reverse direction to or beyond opposite sides of the gate, and constituting pull devices for starting the gate in opening and closing it, a spring connecting the projection with the back or hinge gate post, and operating to complete the opening or closing of the gate.

NEW BOOKS AND PUBLICATIONS.

GEOLOGICAL SURVEY OF NEW JERSEY. Final report of the State geologist. Vol. II. Trenton, N. J. 1889. Pp. x, 642.

In this second volume of the final report of the lamented Prof. Cook, mineralogy, botany, and zoology are comprised. It amounts to little more than a catalogue of the subjects, with the localities or places where found, given under many of the titles. It is needless to say that it will be of great importance and interest to those scientists to whom it is particularly addressed.

SEWAGE DISPOSAL WORKS. A guide to the construction of works for the prevention of the pollution by sewage of rivers and estuaries. By W. Santo Crimp. London: Charles Griffin & Company. Philadelphia: J. B. Lippincott Company. 1890. Pp. viii, 277. Price $7.50.

A subject of importance, and one which is daily acquiring new importance in the suburbs of our large cities, is that of sewage disposal. In this work the different plans adopted in England are elaborately explained and illustrated. It is offered as a guide for the construction of works for large and small cities, and illustrates a subject which is only at the present day beginning to acquire its proper position in sanitary engineering in this vicinity. Numerous folding plates illustrate the subject.

PRACTICAL BLACKSMITHING. By M. T. Richardson. Vol. III. New York: M. T. Richardson. 1890. Pp. i, 307. Price $1.

We welcome most heartily the appearance of the third volume of this excellent treatise on a subject neglected by most technical authors. The numerous illustrations and detailed instruction are such as to bring this very practical science well within the understanding of all. The most experienced blacksmith will receive many hints of use and value upon points in his trade.

THE CIDER MAKER'S HAND BOOK. A complete guide for making and keeping pure cider. By J. M. Trowbridge. New York: Orange Judd Co. 1890. Pp. 119. Price $1.

Judging by the many inquiries made about the manufacture of cider, there is every reason to believe that the present work will be acceptable to a large number of readers. It has several illustrations, and many tables of data are appended to it.

DUST AND ITS DANGERS. By T. Mitchell Prudden. G. P. Putnam's Sons. New York. London. 1890. Pp. iii, 111. Price 75 cents.

Dr. Prudden's exhaustive work on bacteria gives his emanations on the subject of dust and its disease germs a peculiar value. The most practical methods of analysis were applied to determine the quantities of dust and of germs growing thereon, from which numerous illustrations are given, showing the results obtained under a microscope.

WOOD'S MEDICAL AND SURGICAL MONOGRAPHS. William Wood & Company, New York. 1890. Pp. 291. Price $10 a year, single copies $1.

In this, the first number of the sixth volume of this very valuable series, the human foot, modern cremation, and aphasia are treated. We have before this reviewed the series, and need only say that this number yields nothing to the others in interest and beauty of illustration. The colored plates and the very practical outline drawings appeal to the laity almost as much as to the medical world.

ELEMENTS OF PLANE AND SPHERICAL TRIGONOMETRY. By Edwin S. Crawley. Philadelphia: J. B. Lippincott Company. 1890. Price $1.

This work is supposed to comprise the subject of trigonometry as far as treated in the college course. The method adopted has been to give the first portion in detail and later on to throw the student more upon his own resources. It includes both plane and spherical trigonometry.

THE LIGHTING IN PHOTOGRAPHIC STUDIOS. By P. C. Duchochois. New York. Pp. 88.

A practical work on the various modes and appliances used in lighting sitters in photographic studios. The general principles to be observed in making portraits; methods of distributing the light, the construction of the skylight, devices for screening and shading the light; backgrounds and their relation to the sitter; the use of orthochromatic plates in portraiture, are all fully described and explained. The book is designed for the practical photographer, and contains much useful information compressed into a small space.

THE DEVELOPMENT OF GELATINE DRY PLATES. A practical manual for the amateur. By Rev. W. H. Burbank. Brunswick, Maine. Pp. 92. Price 75 cents.

The book covers thirteen chapters, explaining the general principles of development, illustrations of developing room conveniences, giving formulas of the various developers, describing methods of washing, fixing, intensifying, and reducing negatives. There are also supplementary notes, formulas, and tables for reference which will prove very useful to any amateur desiring to know all about development. The book has the merit of being free from strictly technical terms and is easily understood, and the directions to be followed in developing a plate are carefully and concisely written. As a whole it is a desirable and useful addition to photographic literature.

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.

(2570) F. J. McV. asks: Will you please inform me what kind of a paste or cement I can use to fasten a strip of wood to glass and brass? A. Melt together equal parts of common pitch or Burgundy pitch and gutta percha.

(2571) J. H. H. asks: What is the ratio of the increase in rapidity of vibration of the strings of a piano forte in the ascending scale for one octave? That is, a piano string, in sounding a particular note, vibrates so many times per second, the string that sounds the tone above vibrates a certain degree faster, and so on. Can you say what the ratio of the increase is for each note of the eight components of an octave? A. The vibrations of musical notes are arranged under two systems, the harmonic scale as fixed by the congress of Stuttgart and the tempered geometric scale. In the Stuttgart scale C below the treble clef has 264 vibrations; E, 330, with intervals for each half tone of 16½ vibrations; A has 440 vibrations, with intervals of 22 for each half tone from E. C in the clef has 528 vibrations, with intervals of 27½ between A, A sharp and A B; while from B to C is 33 vibrations difference. The geometrical system has the same octave vibrations of C as in the harmonic, but with a geometrical ratio of increase for each semitone, which ratio has a variable. It is too complex for full explanation here. You will find the whole tabulated in full for 8 octaves in Nystrom's Mechanics, $3.50 mailed.

(2572) W. H. B. asks: What is the precise nature of the work of a mechanical engineer? Is it work that could be performed by a man who has had only shop experience and a general education, but no technical education? Does mechanical engineering or civil engineering offer the better chance for position and advancement? A. Designing is the principal forte of the mechanical engineer. This requires a technical education in the principles of mechanics, ability as a draughtsman and experience as a guide. With all these he has a fair start for success in a business way. Shop experience is one of the necessities. The other essentials are matters of study and aptitude within the power of the aspirant for mechanical fame. The civil engineer requires a higher education and a more extended experience in the mathematical and mechanical relations of the forces of nature. Both pay in their way.

(2573) J. F. S. says: I wish to construct an aquarium, size 2½ by 1¼ by 1¼ feet, bottom of wood and corner posts of wood, fastened by iron rods running through center of post, and bottom. I wish to know what is best wood, to use. How should wood be prepared to prevent leakage or dampness warping and cracking glass. Cement for corners and bottom edge. A. Make the frame of your aquarium sides and bottom of oak, with glass in bottom. Boil the frame before putting together in linseed oil for a few minutes. Make a cement of equal parts of litharge, fine white sand and plaster of Paris. Mix with boiled linseed oil, with a little drying oil, to a stiff putty. Let it stand a few hours before using. A frame bottom with glass is better than a solid wood bottom.

(2574) W. P. asks: 1. What is meant by a volt? I have seen it mentioned in several papers, but no two explain it the same. A. The volt is the unit of electromotive force or pressure of the current. The current from one cell of gravity battery has an E. M. F. of slightly more than 1 volt (1.07). 2. What is meant by shunt wound dynamos? A. A shunt wound dynamo is one in which the terminals of the armature are connected with the terminals of the field magnet and also with the external circuit, so that the current divides at the brushes, a part passing through the field magnet, the remainder through the external circuit. 3. How is the voltage measured in dynamos and batteries? A. Voltage or E. M. F. is measured by means of a voltmeter, or galvanometer. Consult any work on physics or electricity.

(2575) D. B. A. says: Some years ago a dam was built across a river here, and a short time since began leaking badly. Upon examination it was found cheaper to build a new dam than to repair the old one, consequently a new one was built, but a little further down the stream, and the water filling in soon became level on both sides of the old dam. Now a discussion has arisen as to which dam supports the pressure of weight of water in the lake above. One party contends that the old dam has still the same pressure upon it as formerly, while the other party claim that the new dam has now the whole pressure of the lake against it. A. The new dam supports the whole pressure of the lake as long as the water covers the old dam, which has the pressure on both sides of it, and is, in consequence of this balanced pressure, a neutral point. If there was a difference of level in the water above and below the old dam, the pressure would be divided by the hydrostatic difference of level.

(2576) H. G. C. asks: What kind of material shall I use for tanning alligator hides? A. Bark is mainly used for the tanning, but a special technical knowledge, possessed by but few in the trade is required for the preparation of the skins for the tan liquors, in order to make good leather.

(2577) A. E. B. says: Some people say that the B. B. caps No. 22 are injurious to the rifling of a gun. Is this so, and why? A. The B. B. are no more injurious than other caps of less strength, if the gun is properly cleaned after use. It is allowing the products of combustion to remain in the gun, even for a day, that does the mischief, by starting oxidation in the rifle grooves. In cleaning, the wiping wad should go tight and follow the rifle grooves, otherwise the dirt will lodge in the grooves and roughen them by oxidation.

(2578) E. R. D. D. says: I have two wells, 38 feet and 35 feet deep respectively. In the first well is placed a steam pump, 10 feet from the top of well. Can I run a suction pipe from this pump, over the ground and down into the second well, and draw all the water out of it? The wells are 30 feet apart. A. You cannot draw all the water out of the second well, but by digging a trench for your suction pipe 5 feet deep, you may be able to draw the water down to within 3 feet of the bottom, possibly a little nearer.

(2579) N. O. L. asks: When a gun is discharged, what is the cause of the noise or report? Is it concussion of the air, or has it anything to do with the vacuum produced in the barrel? A. The noise of a gun is caused by the concussion or vibration of the air at the instant of the charge leaving the gun. There is no vacuum formed, but on the contrary a momentary pressure made by the expansion of the gases or powder smoke.

(2580) J. H. G.—The plant sent for identification is a small form of *Helenium tenuifolium*, Nutt.

Replies to Enquiries.

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

(2475) If P. C. N., of query No. 2475, will thoroughly smoke his buckskin articles with any ordinary wood fire, the same as bacon is smoked, say hang them up in some closed building and build a good smudge under them three or four times each day for about a week, being careful not to get them too hot, he can then wash them the same as any woolen cloth is washed, and I guarantee, they will not get hard if the buckskins are thoroughly tanned.

Splitting Wood.—Please tell your inquirer of query No. 2459 to use 3 C blasting powder for splitting wood. If he cannot get this grade at the hardware store, to get either single F, double F, or E F blasting powder. Three C is the slowest powder made. It is the best for quarrying large fine stone or splitting straight-grained wood. When it explodes it merely gives a grunt, but it is sheol for smoke. Single F is the next quickest, double F the next, and 3 F the next. Judging by his query, he does not live in a mining district, and it is quite probable that he cannot get blasting powder. He should not use gunpowder by itself for splitting wood, unless it is very hard to split, as it would be liable to put a splinter in his eye. If he has to use gunpowder let him mix it with fine sand, one-third sand, two-thirds powder. The sand reduces the strength of the powder, but not its quickness. Gunpowder itself is too quick for wood, stone, or coal. Coal miners can use their drill dust instead of sand.—H. B.

INDEX OF INVENTIONS

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November 4, 1890,

AND EACH BEARING THAT DATE.

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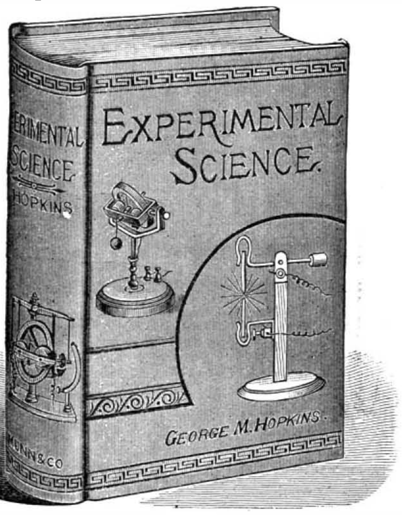

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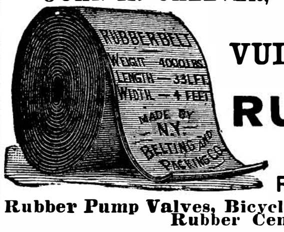

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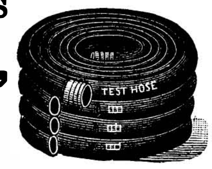

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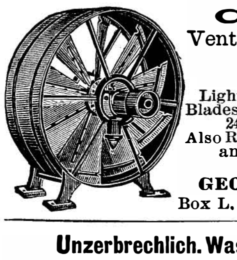

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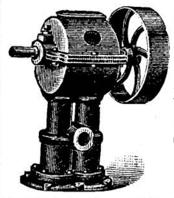

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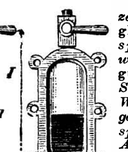

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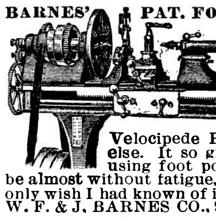

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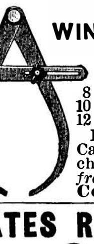

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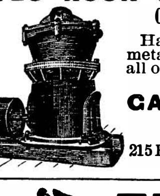

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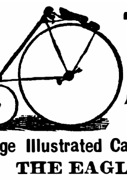

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Proposals for Improving Entrance to Galveston Harbor. U. S. ENGINEER OFFICE, Galveston, Texas, October 25, 1890.—Sealed proposals, in duplicate, will be received at this office, until 12 o'clock, noon, 90th meridian time, December 27, 1890, and then opened, for delivery of materials in place for improving the entrance to Galveston Harbor, Texas. Preference will be given to materials of domestic production or manufacture, conditions of quality and price (import duties included) being equal. The attention of bidders is invited to the Acts of Congress approved February 26, 1885, and February 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, U. S. Statutes at Large. For blank forms for proposals and all necessary information, apply to CHAS. J. ALLEN, *Major, Corps of Engineers.*

U. S. Engineer Office, Room 62, Army Building, New York, October 29, 1890.—Sealed proposals, in triplicate, will be received at this office until 12 o'clock noon, Monday, December 1, 1890, for the delivery at Sandy Hook, N. J., of 41,000 cubic yards of broken stone (granite, trap, or limestone) and 62,000 barrels of Rosendale cement. The attention of bidders is invited to Acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, vol. 23, p. 332, and vol. 24, p. 414, Statutes at Large. For full information, apply to G. L. GILLESPIE, *Lieut. Col. of Engineers.*

U. S. Engineer Office, Room 62, Army Building, New York. October 15, 1890.—Sealed proposals, in triplicate, for dredging the channels in Newtown Creek, N. Y., Gowanus Bay, N. Y., and Raritan Bay, N. J., will be received at this office until 12 o'clock, noon, Friday, November 21, 1890. Aggregate amount available, $215,425. The attention of bidders is invited to Acts of Congress approved February 26, 1885, and February 23, 1887, vol. 23, page 332, and vol 24, page 414, Statutes at Large. For specifications, blank forms, and all information, apply to the undersigned. G. L. GILLESPIE, *Lieut. Col. of Engineers.*

U. S. Engineer Office, Room 90, 134 Van Buren St., Chicago, Ill. October, 20, 1890.—Sealed proposals in triplicate will be received at this office until 12 o'clock, noon, Wednesday, November 19, 1890, and opened immediately thereafter in the presence of bidders, for the following harbor improvements, viz.: Dredging Calumet River, Illinois and Indiana. Dredging Calumet Harbor, Illinois. Proposals will be accompanied by a guarantee that if the bid be accepted, contract will be entered into within 10 days after notice of acceptance. The United States reserves the right to reject any or all bids. The attention of bidders is invited to the Acts of Congress approved February 26, 1885, and February 23, 1887, vol. 23, page 332, and vol. 24, page 414, Statutes at Large. For specifications, blank proposals, and all other information apply at above address to CAPT. W. L. MARSHALL, *Corps of Engineers, U. S. A.*

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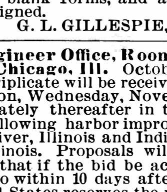

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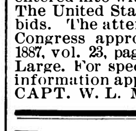

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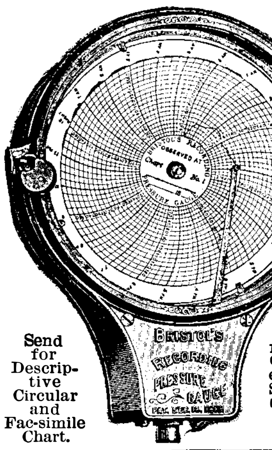

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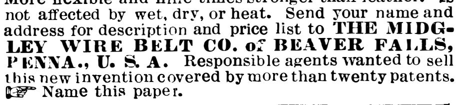

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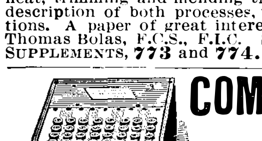

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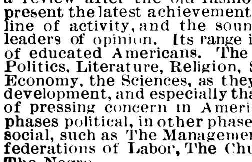

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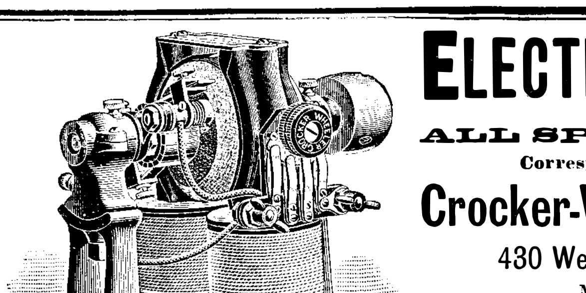

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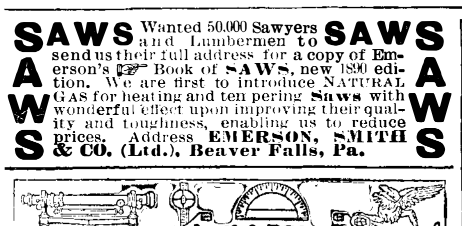

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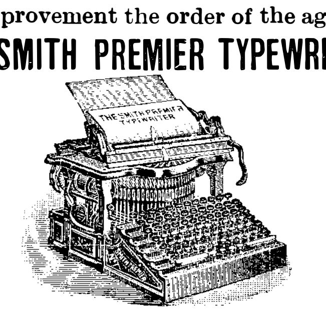

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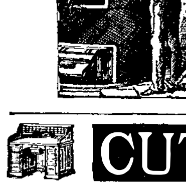

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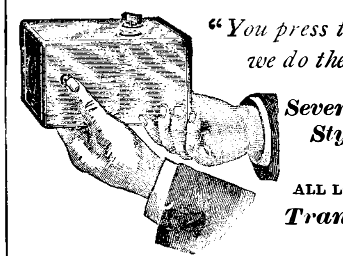

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