SCIENTIFIC AMERICAN

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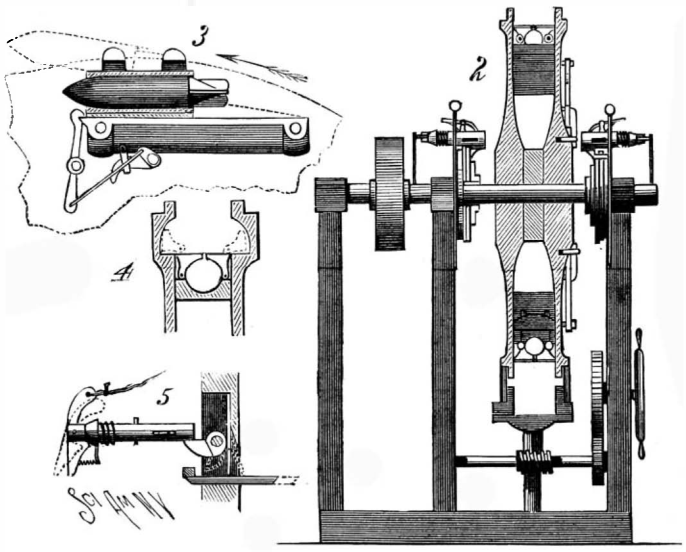
A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

Vol. LIX.—No. 26.] ESTABLISHED 1845. | NEW YORK, DECEMBER 29, 1888. | [$3.00 A YEAR. WEEKLY.

NEW DYNAMITE GUN.

From time to time we have published accounts of the various experiments that have been made of late years in ordnance for the discharge of the high explosives. During the past eight years, the value of dynamite, gun cotton, nitro-glycerine, mercury fulminate, etc., for use in warfare, has been thoroughly appreciated, and the only problem to solve has been how to handle these explosives with less destruction to one's self than to the enemy. This has not been altogether so easy of accomplishment. It is believed that the problem of throwing large charges of explosives to a considerable distance has been accomplished by Capt. Zalinski's dynamite gun, in which the inertia of the shell in the gun is gradually overcome by subjecting it to a gradually increasing pressure of compressed air. The experiments to this end have been successful, and the shell leaves the muzzle of the gun at a very high rate of speed, while the initial shock is comparatively slight. Owing to the peculiar structure of the projectile used in this type of gun, the range is somewhat limited. We have also illustrated a dynamite gun in which common gun powder was used as the propelling power. In both of these guns the shell is made of a peculiar type, being adapted to take up the initial shock of discharge.

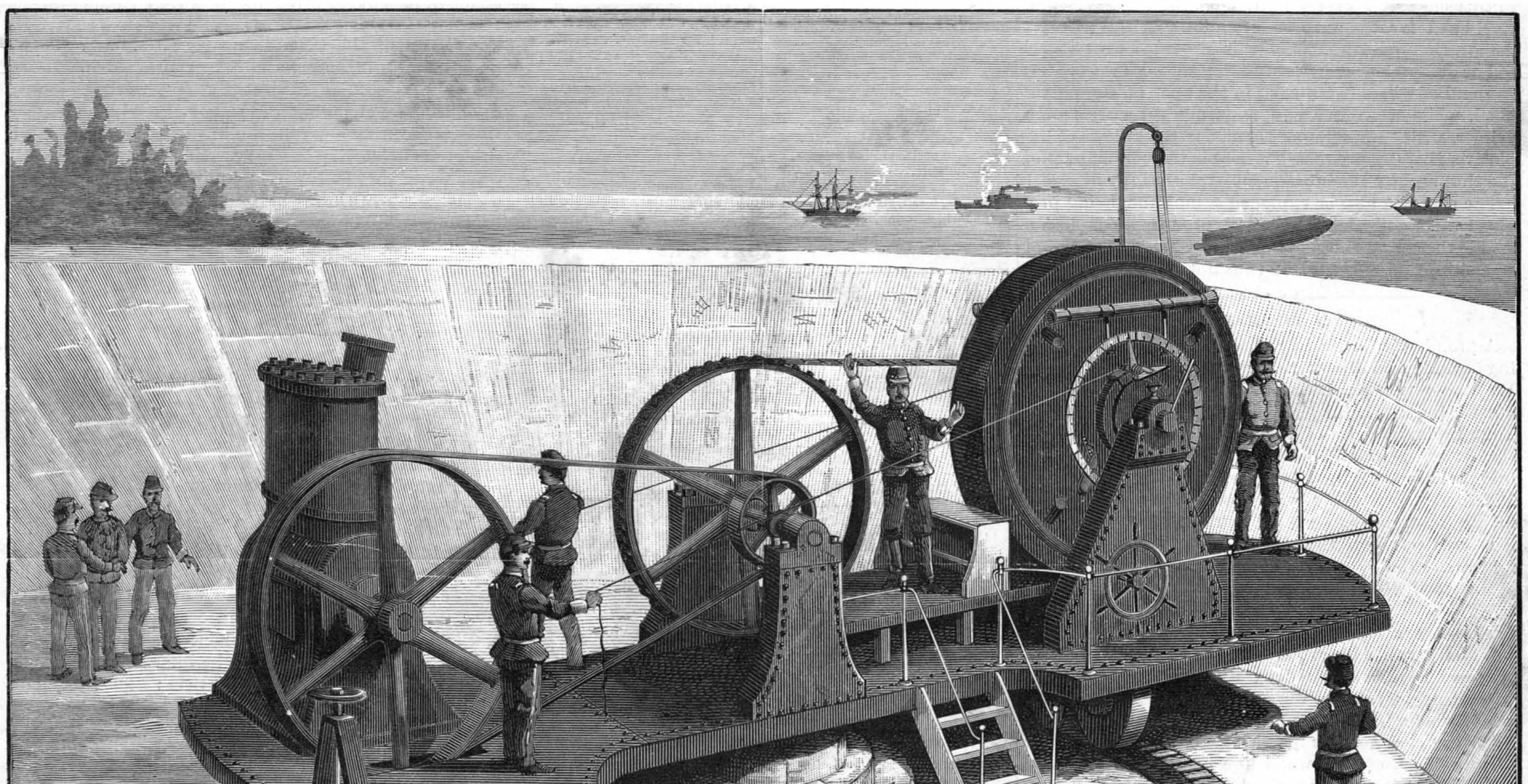
In the gun which is illustrated below, and which is the invention of Walter E. Hicks, of New York City, the danger of self-destruction from accidental explosion at discharge has been reduced to a minimum, as there is absolutely no shock, the shell being projected by the rotary motion of a revolving carriage. As this motion begins with a slow movement, gradually increasing in rapidity, there is no jar or shock until the projectile has been discharged and has come in contact with some obstructing object. The power that is employed to this end is centrifugal force—that force which bursts grindstones and tears them into a thousand pieces, and which dashes flywheels to destruction. It is that same force which, according to La Place, gives the planet Saturn her beautiful rings.



DETAILS OF DYNAMITE GUN.

The rotatable carriage from which the projectiles are discharged consists of two steel disk wheels (see detail) mounted parallel upon a shaft, which is provided with a pulley wheel for connecting it with a steam engine, or any high power motor, by means of which the carriage may be set at a high rate of rotation. These wheels are constructed thick and strong at the point at which they connect with the shaft, in order to resist the great strain, which is measured by the square of the velocity multiplied by the weight of the carriage. The gun represented in the cut is constructed for carrying four charges at a time, each of which may be discharged in rapid succession. The projectiles are inserted in carriers or chambers (see Figs. 3 and 4), which are arranged between the wheels at equal intervals from one another, and near the periphery of the wheels. The projectiles fit closely in these chambers, where they are firmly held until the instant of discharge by two doors, which lock and unlock automatically, and which hold the projectile in a vise-like grip.

The end of the carrier is journaled in the side of the wheels, and the other end is left free to oscillate in radial slots in the wheels. The free ends of these carriers are held down when loaded and locked by clutch bars meshing in teeth on the free ends, the clutches being attached to a shaft connected with the firing mechanism; when the gun is to be discharged, the clutch bars are released from the free ends of the carriers, which fly upward by reason of the centrifugal force exerted upon them, the doors fall automatically (see Fig. 4) into recesses in the sides of the wheels, and the projectiles, having received their momentum from the rotary motion of the carriage, are projected into space. As was observed, the carriers are pivoted at one end, which allows a certain amount of outward play, for the



NEW MILITARY ENGINE FOR THROWING DYNAMITE SHELLS.

reason that when a body is suddenly set free from the outer edge of a revolving disk or carriage, that body, owing to the centripetal force, will follow a curved path, therefore, the projectile carriers are mounted to admit of a certain amount of outward play in order to counteract to a certain extent their tendency toward a curvilinear trajectory. The gun can be used as a mortar for high angle fire or close siege work, and is also adapted for long range. The journals on each side of the wheels are provided with flanges and concentric disks (see Fig. 2) which revolve on sleeves extending on the inside of the journals. These concentric disks have the firing bolts attached to the peripheries (see Fig. 5); and they are adjusted by caps and set screws to the journal flanges, the whole being surrounded by an annular rim, indexed with the degrees of two quadrants, so that by adjustment of the concentric disks, the alidades attached to the sleeves through which the firing bolts slide will point to the degrees of elevation or depression desired.

The gun can be discharged at any angle in the vertical plane, while the arc of fire in the horizontal plane is the same as in any other piece of ordnance. The tripping device on the rotary disk is arranged in such a way that the shell can be discharged at the point previously fixed upon; this being entirely arranged before discharge by the position of the quadrant. The tripping devices for two of the carriers are located upon the right hand disk, and those for the other two carriers on the left hand disk, whereby two of the shells may be discharged at a time, the other two being left in the carrier until it is desirable to discharge them. The four shells may be discharged in rapid succession, and the trajectory of each being practically identical, each successive shot will add to the destruction done by the preceding one. One peculiarity of the gun or engine, as it might perhaps more properly be called, is its comparative noiselessness. There being no expansion of gases and no vacuum, there is no report of any kind, the only sound being the whiz of the shell as it passes through the air. There is neither flash nor smoke, report nor recoil, and there is nothing to apprise an enemy of the whereabouts of the gun, and the destroyer might come in the midst of an enemy unseen and unheard. It is hoped that a thorough trial of this new gun will be made, from which data may be obtained concerning the efficiency, range, and practicability of this as a weapon of warfare.

The combination shot and shell designed to be used in this engine is of regulation shape, having a solid steel head for the purpose of producing the greatest penetration upon impact. It is provided with a steel rod or precussion striker, extending through the center, one end of which is adjusted in the apex of the ogival head, while the other end rests against a precussion primer, which upon impact explodes the charge of explosive, thereby producing a double blow by impact of the shot and by the subsequent explosion.

The shot can also be exploded submarine, being provided with a device which will produce an explosion in case the target should be missed. Should that target be a ship, that effect would thus not be wholly lost.

Finish for Redwood.

A prominent dealer in redwood supplies the following formula and directions for treating redwood finish. We understand it is a practice that has been indorsed by successful experience in San Francisco. Take 1 quart spirits of turpentine, add 1 pound corn starch, add ¼ pound burnt sienna, add 1 tablespoonful raw linseed oil, add tablespoonful of brown japan. Mix thoroughly, apply with a brush, let it stand say fifteen minutes, rub off all you can with fine shavings or a soft rag, then let it stand at least twenty-four hours that it may sink into and harden the fibers of the wood; afterward apply two coats of white shellac, rub down well with fine flint paper, then put on from two to five coats best polishing varnish; after it is well dried rub with water and pumice stone ground very fine, stand a day to dry; after being washed clean with chamois, rub with water and rotten stone, dry, wash as before, clean, and rub with olive oil until dry. Some use cork for sandpapering and polishing, but a smooth block of hard wood like maple is better when treated in this way. Redwood, according to a Californian's idea, will be found the peer of any wood for real beauty and life as a house trim or finish.

Lighting by Means of Accumulators.

At Springfield, Mass., the electric light company have recently put into their works on Taylor Street the system of the Electrical Accumulator Company, of New York, composed of 378 large cells, which take up a floor space of about 20 by 15 feet, and they stand about 8 feet high. The company are able to store electricity enough in the accumulators to run 500 lights ten hours. In this way they are able to do more work with the same amount of engine power, as the engines can be used to store up electricity during the day for use in the night, and then the same motive power can be used to propel the arc dynamos at night.

Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, NEW YORK.

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

TERMS FOR THE SCIENTIFIC AMERICAN.

One copy, one year, for the U. S. or Canada.......................$3 00
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The Scientific American Supplement

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Address MUNN & CO., 361 Broadway, corner of Franklin Street, New York.

NEW YORK, SATURDAY, DECEMBER 29, 1888.

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(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 678.

For the Week Ending December 29, 1888.

Price 10 cents. For sale by all newsdealers.

DOGS THAT LEARN TRADES.

The dog corps, long since established in the French army, has been recently much increased, so efficient have these little soldiers become. At an early stage of the trials they gave satisfaction as advanced posts, scenting or hearing a stranger approaching even in the darkness, and quickly learning the difference between a friendly and a foreign uniform. The latest trick the military dog has learned is that of carrying dispatches between distant sections of an army or reliefs or re-enforcements presumably advancing through hostile country. The system is an offshoot of the dog smuggler system, which is described in the current number of *Blackwood's*, and the steps by which the animals are taught to understand what is wanted of them are best shown by reference to that article.

The smuggler in broad day walks across the frontier, his dog by his side, leaving the latter at the house of his accomplice and returning without him. When night falls, the dog is given a beating and turned loose to find his way home. Next he has a small packet fastened to his collar, and gradually the burden is increased. Then half a dozen or more are employed at the same time; the most intelligent being given no burden, that he may the more readily act as a scout for the others. He goes ahead, they keeping well back, till he gives them the signal that the coast is clear. The customs dog from its earliest years is made to play hide and seek with bags of coffee, rolls of lace, packages of tobacco, and the like. They do not bark, being taught to sit silently in ambush and give a low growl or simply cock up their ears and point the true direction of the advancing pack.

The French army dogs, mastiffs, like the smugglers' dogs, though first they must be taken from point to point to find them again, when they get to understand the idea, and what is wanted of them, will find a distant column or command with little difficulty if given the general direction, unless it be at too great a distance, and carry messages to and fro with commendable zeal.

"A POSSIBLE REVOLUTION IN MEDICINE."

Most people have read of the bacteria and of the discoveries concerning them made by Pasteur and Koch. The subject seems generally to be regarded as belonging to the doctors—an interesting phase of the progress of our time and something for students to sit up late over, but not directly interesting to lay minds. This seems to be a grave error, for, in a recent paper on "A Possible Revolution," Dr. Austin Flint says that by a knowledge of the bacteria nearly all human ills of a physical nature may be cured or prevented. Hence there is no secular subject that may fairly be looked upon as more engaging and timely. Slowly, but surely, there is working a revolution in the science and practice of medicine and surgery. He thinks a time will come when the cause will be known of every infectious disease; when they will be preventable, or having broken out, will be easily curable; and, best of all, when it will be possible for the intelligent physician to afford protection against all such diseases as scarlet fever, measles, yellow fever, whooping cough, etc.

Indeed, there need not be any epidemics, and even constitutional diseases will be curable if only the progress in the science of bacteriology should go on at the present rate, because, in a figure which the Doctor borrows from the French, "The higher one ascends, the further off seems the horizon." That is to say, the further we go in bacteriology, the greater appears the promise. In the last few years there has been a really remarkable advance, "an evolution of knowledge," the author calls it. There is "Pasteur's work with the fermentations, his discovery of the microbe which breeds in the silkworm a peculiar disease, and especially the isolation of the microbe of the carbuncular disease of sheep—which sometimes attacks man. These give a powerful impulse to the study of bacteriology." Koch's part in the bacteriological era would seem, from what our author says, to be somewhat similar to that of Ampere in electro-magnetism; he supplemented Pasteur's discovery, as Ampere did Oersted's.

Bacteria, which are now known to be vegetable and not animal growths, are to be found in large numbers in the intestines even of the most healthy, and it is in knowing the nature and habit of these that will enable the student to prevent their inroads when the condition of the system leaves it disarmed. Even now, so we are told, consumption can no longer be called incurable, fermentive indigestions are successfully treated by means of a class of remedies known as disinfectants. In many of the skin diseases is found an organism at work; in diphtheria the germs are at work in the mucous membrane. In both cases the physician now addresses himself particularly to dealing with these germs. Among the diseases in which, our author says, the presence of bacteria has already been surely traced, and their influence depressed or destroyed, to the relief or cure of the patient, are: Tuberculosis, diphtheria, typhoid fever, yellow fever, relapsing fever, the malarial fevers, certain catarrhs, tetanus, nearly all contagious and skin diseases.

The Scientific American for 1889.

READ WHAT THE PUBLISHERS SAY.

The increasing circulation of the SCIENTIFIC AMERICAN enables the publishers to improve the paper every year, while the subscription rates are kept at the lowest possible figure. The year just closing bears witness to these facts; and with a still further increase of patrons for the coming year, which we are encouraged to expect, still greater improvement may be expected. We look upon our readers as our friends, for whom we are willing to devote our time and our best energies, and for enquirers through our "Notes and Queries" column we do incur large expense to secure accurate information. The recipes and directions offer practical hints in engineering and physics and in every department of science. The large number of beautiful wood engravings which embellish each number of this paper speak for themselves; in fact, our tens of thousands of regular patrons, some of whom have taken the SCIENTIFIC AMERICAN from its infancy, more than 40 years ago, know without being told how the quality of the paper has advanced with its years, until it has attained an eminence and circulation to which none other of its class at home or abroad approximates. We would remind our readers that this number closes a volume, and with it the subscription of several thousands of our patrons expires, and before the end of another week we trust that every one will not only renew his own subscription, but include some friend, the manager of his works, some worthy employe, an apprentice, or some bright boy who has a taste for mechanics or some special department of science. It will make a useful as well as an acceptable New Year's gift, and the recipient every week for a whole year will be reminded of the donor's good deed, and will, undoubtedly, be a more intelligent and better man from the instruction he will derive from its weekly perusal. Price only $3 a year, and for so small a sum we shall feel disappointed if several thousand more names are not entered on our subscription books for 1889 than were recorded in 1888.

Bursting of the New Steel Gun.

Before this gun was tested I predicted that it or any other cast steel gun would be a failure. My reasons for this were that no cast steel gun could be made that the metal would be of regular tension. In 1869 I visited the steel works of Mr. Krupp, in Essen, Prussia, where I was at that time fortunate enough to see them forging the largest ingot of steel that, up to that time, had ever been made in the world. It weighed 82,500 pounds, and was being forged under the then largest and heaviest steam hammer ever made, the hammer of which alone weighed more than 50 tons, and struck a blow of more than 100,000 tons; when forged, one-third of the upper or pipe end of the steel was cut off.

Mr. Krupp explained that no mass of molten metal of near that size would be of uniform tension when cooled, because the outside must cool faster than the center, and shrink on it like a band shrunk on it. Then the center shrinks from that in cooling. He also said that, in order to forge the steel for a gun, it was necessary that a steam hammer be of sufficient weight to move the metal clear to the very center at every blow in order to leave it of uniform tension; that if a hammer that was itself too light, in forging that the outside would be enlarged more than the center, and it would be also of unequal tension.

During the war I lived in Trenton, N. J. At that time a gentleman, then living in New York, received an order for a cast iron cannon to be of 8 inch bore. The cannon was constructed with deep spiral ribs extending around the breech, and it was of immense weight. It was taken about three miles below Trenton in a dugout made by the Camden and Amboy Railroad Company for a fill in building the road. It burst at the first charge, the breech going into three pieces, one, weighing many tons, more than half a mile into an oat field. I was on the ground on the Sunday after and saw the wreck.

During the war I was in Washington, and in front of the war department building was a Rodney gun. It was a gun made by shrinking rings over the breech to a little below the charge. While I stood there, among numerous other curious visitors, and all apparently admiring the gun, Fred Sickles, of Sickles cut-off, came up and looked it over. A gentleman in the crowd said: "Mr. Sickles, what do you think of it?" Said he, "Well, it will never stand seven charges. It will crystallize by unequal tension right where the rings terminate."

I had the curiosity to watch the result of the first Rodney gun. It was put on the Naugatuck and burst, just as Sickles said it would, at the fifth round.

I am, therefore, of opinion that no cast gun will ever be a success. Failure will not be in consequence of imperfect annealing, but of improper tension.

J. E. EMERSON.

Collisions in Fogs.

In his annual report to the National Board of Steam Navigation, President Cheney shows that there were in 1887, 84 casualties to vessels from collisions in fogs; 100 in 1886, 120 in 1885, 92 in 1884, and 59 in 1883. He gives a statement by Captain H. C. Taylor, U. S. Navy, who says:

The general idea on shore and among seafaring people who do not reflect and observe closely is that, if you are going slower, you can stop easier; if going at a high rate of speed, it takes longer; but the real fact is that, for all purposes of avoiding impending collisions, it is impossible to stop at all when at high speed, within any period needed to avoid collision.

Those who have practically tried it, know that when a large seagoing vessel is rushing through the water 12 or 13 knot speed, that the first effect of the propeller or paddle wheels backing is in no way perceptible. The momentum of the ship begins to be lost by the natural resistance of the water, and when checked somewhat, the effect of the screw commences to be felt, and not before. No heavy vessels (whose momentum becomes so great as their speed increases) should go more than six knots per hour in a thick fog, if they hope to avoid collision; and a speed of eight to nine knots renders avoidance impossible.

The investigations and experiments of Captain Colomb, R.N., with many steam screw vessels, of different size, and moving at different speed, show that the average distance in which a steamer will stop after suddenly reversing the engines is four and one-half times the ship's length.

Some experiments made with the SS. Aurania, 480 feet long, and moving at a speed of thirteen knots, showed that she came to a dead stop in three and six-tenths times her length, after reversal of the engines.

The case of the Aurania is a very favorable one, and indicates that, though not at full speed, she stopped in one-third (1,728 feet) of a mile. All of us who are familiar with thick fogs will realize the uselessness of stopping only after one-third of a mile has been covered.

Experiments with the SS. Oregon gave the same results; the time to come to a dead stop being 3 minutes and 59 seconds.

The mean results of many trials with different sized vessels, and moving at different speeds, show that to stop a vessel in the shortest possible space, the helm should be put hard over the instant the engines are reversed. If this is done, the vessel will lose way and come to a state of rest when she has changed her heading four points. She will then have moved ahead a little less than *three times her length*, and will have transferred *one length;* that is, her stern will be just clear of her original course.

The dragging action of the rudder, as mentioned above, is well known to all seafaring people, and can generally be utilized to avoid collision, unless danger exists on both bows. But we must remember that the above results were obtained largely in quiet weather and smooth water; and a strong breeze or rough sea is liable to alter the above results as to the movement of the ship's head.

Manufacture of Hydraulic Cement.

According to Dr. Michaelis, the foremost cement expert now living, the raw materials, when dried at 212° F., consist essentially of 75 to 79 percentum (by weight) of carbonate of lime and 24 to 20 per cent of silicate of alumina (clay). These, when burned, represent 62½ to 67 per cent of lime and 33½ to 29 per cent of silicates (silica, alumina, oxide of iron), leaving 4 per cent for accessories. After the hardening of the hydrated cement, a transformation, by complicated reactions, has taken place into hydrated silicate of lime, as the most important ingredient, in hydrated aluminate of lime, ferruginous lime, hydrate of lime, basic sulphate of lime, and carbonate of lime.

Some of the phases during the burning, as well as during the hardening process, are of interest and importance.

The constituents being pulverized are mixed into a homogeneous paste, balled, dried, and burned by exposure to a quick white heat, equal to the melting point of wrought iron. This causes first the expulsion of the chemically bound water and carbonic acid, and next a softening of the whole mixture. During the calcination alumina and oxide of iron, which acted in the clay as bases, assume the role of acids toward the lime, the calcined oxide of iron acting as a flux in the fire. A preponderance of alumina favors the production of a quick-setting cement, while an increase of iron has the opposite effect, since it arrests the eager absorption of water by the lime, which causes it to swell.

When partial vitrification sets in the heat is promptly stopped, since a higher heat or a continued oxidizing heat of the normal temperature will ruin the cement, which now requires rapid cooling as much as it did a quick heat before. At this stage the softened lime is alloyed with the softened clay, while neither is in fusion yet. A disposition for the formation of new combinations of lime, with silica, alumina, and oxide of iron, is induced without allowing these nascent combinations to be fully consummated, because they, as crystalline bodies, would impede the subsequent hydration and the dense interlocking of the molecules during the setting or crystallization processes. Under these conditions the lime, though not chemically combined, is engaged and kept out of harm's way.

The high temperature of the kiln has gradually condensed the mass and most prominently the silica. The globular texture attained in moderate heat was simultaneously transformed into a laminated semi-vitreous texture.

The Portland cement owes its high reputation largely to such physical changes. Globular texture makes contact by points, while laminated texture achieves more intimate contact by surfaces. In our case it secures in strata of height 50 per cent more cementing substance than a mass of globular particles.

This close packing intensifies cohesion, of which the high tensile strength is the exponent. After cooling the clinkers are ground to impalpable, dense, drossy, steel-hard powder, having a specific gravity of 3·0 to 3·15. A few weeks' storage seasons the product and makes it ready for use.

Manufactures in Japanese Prisons.

A visitor to a Japanese prison in Tokio thus recounts, in the *Pottery Gazette* (London), a portion of his experiences: Then we visited a workshop where *jinrikishas* were being made, then one where umbrella handles were being elaborately carved, then one where every kind of pottery, from the rough porous bottle and jar to the egg-shell teacup, was rolling from a dozen potters' wheels, and then came the great surprise. Two days previous I had visited the house of the most famous maker in Japan of the exquisite *cloisonne* ware—the enamel in inlaid metal work upon copper—who rivals in everlasting materials the brush of Turner with his pigments and the pencil of Alma Tadema with his strips of metal. And I had stood for an hour behind him and his pupils, marveling that the human eye could become so accurate, and the human hand so steady, and the human heart so patient. Yet I give my word that here in the prison at Ishikawa sat not six but sixty men, common thieves and burglars and peace breakers, who knew no more about *cloisonne* before they were sentenced than a Hindoo knows about skates, doing just the same thing—cutting by eye-measurement only the tiny strips of copper to make the outline of a bird's beak, or the shading of his wing, or the articulations of his toe, sticking these upon the rounded surface of the copper vase, filling up the interstices with pigment, coat upon coat, and fixing and filing and polishing it until the finished work was so true and so delicate and so beautiful that nothing except an occasional greater dignity and breadth of design marked the art of the freeman from that of the convict, *C'etait a ne pas y croire*—one simply stood and refused to believe one's eyes. Fancy the attempt to teach such a thing at Pentonville or Dartmoor or Sing Sing! When our criminal reaches his prison home in Tokio, he is taught to do that at which the limit of his natural faculties is reached. If he can make *cloisonne*, well and good; if not, perhaps he can carve wood or make pottery; if not these, then he can make fans or umbrellas or basket work. If he is not up to any of these, then he can make paper, or set type, or cast brass, or do carpentering. If the limit is still too high for him, down he goes to the rice mill, and seesaws all day long upon a balanced beam, first raising the stone-weighted end, and then letting it down with a great flop into a mortar of rice. But if he cannot even accomplish this poor task regularly, he is given a hammer, and left to break stones under a shed with the twenty-nine other men out of 2,000 who could not learn anything else.

Amphibian of the Coal Period.

Professor Bickmore, in a recent lecture on "The Period of Reptiles and Mammals," in the Museum of Natural History, this city, presented on a screen illustrations of the footprints of one of the amphibians of the coal period. The illustration was a drawing from the great slab of bluestone which belongs to the museum, and was taken from the stone quarry at Turner's Falls, Mass. The animal itself, Mr. Bickmore explained, was one of those which roamed in great numbers along the Connecticut Valley during the carboniferous period. This one had left its footprints in the mud, and the impression having been subsequently filled with sand, the cast was preserved when the clay became hardened into stone.

From fossils of the animal, which have been obtained in other portions of the valley, it appears to have had an elongated body, about fourteen feet long, on four legs. It moved mainly on the hind feet, the fore legs being shorter, and lived partly in the water and partly on the banks of the stream.

SIMPLE EXPERIMENTS IN PHYSICS.

BY GEO. M. HOPKINS.

The engravings represent a few examples of the projection of simple physical experiments upon the screen. Besides a lantern, a few glass tanks with parallel sides will be required. These are preferably, but not necessarily, made of three pieces of plate glass, one a thick piece, having the shape of the cavity cut out of it, the

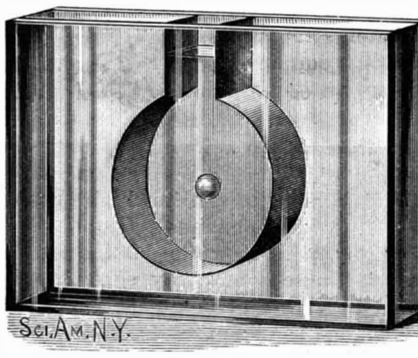


Fig. 1.—COHESION.

others simply flat pieces, attached to opposite sides of the first by means of marine glue or other suitable cement.

A cell made of plates of glass clamped on opposite sides of a bent rubber strip serves a good purpose. It is a great convenience to have several of each kind, so that preparations for projection may be made at leisure.

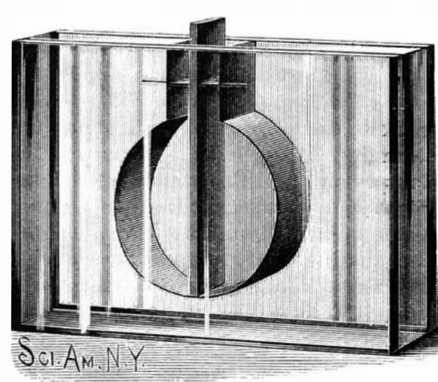


Fig. 2.—REDUCTION OF VOLUME BY MIXTURE.

In Fig. 1 is shown the well known experiment illustrating cohesion. In the tank is placed a mixture of alcohol and water, having the same specific gravity as olive oil. Into the mixture is very carefully introduced a globule of olive oil, which may be colored or not. The oil assumes a perfectly spherical form, and produces a very interesting image on the screen.

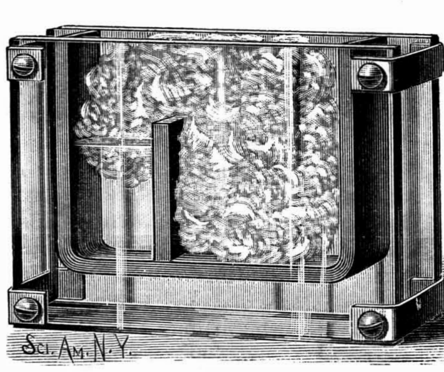


Fig. 3.—COTTON AND ALCOHOL EXPERIMENT.

In Fig. 2 is shown the method of projecting the experiment in which the volume of equal parts of alcohol and water is less when they are combined than it is when they are separate. The tank has a large chamber with a narrow neck. The chamber is divided in the center by a removable partition having soft rubber

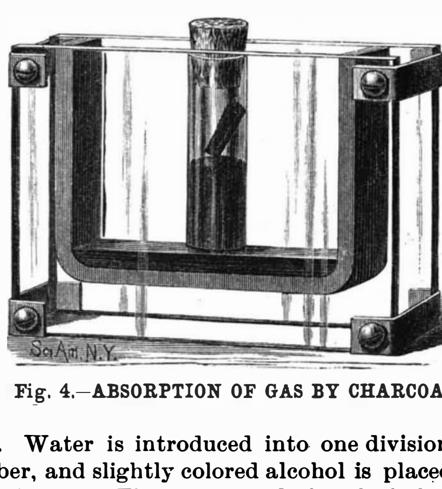


Fig. 4.—ABSORPTION OF GAS BY CHARCOAL.

edges. Water is introduced into one division of the chamber, and slightly colored alcohol is placed in the other division. The water and the alcohol are level with a mark on the glass. On turning the partition, the water and alcohol mix, and the level of the mixture immediately falls some distance below the mark on the glass. After a thorough mixture of the liquids, the partition may be replaced in its first position.

By arranging a tank with a partition near one end, as shown in Fig. 3, the experiment in which a large amount of cotton is introduced into a vessel filled with alcohol, without causing it to overflow, may be repeated so as to show it on the screen. The smaller compartment of the tank is filled with alcohol, and in

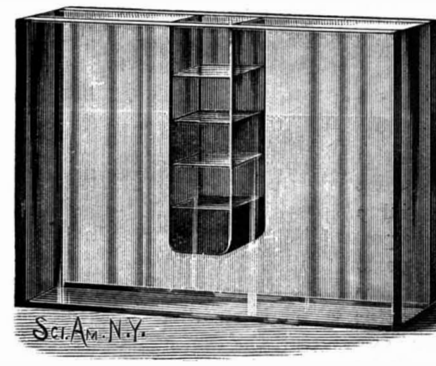


Fig. 5.—EQUILIBRIUM OF LIQUIDS.

the larger compartment is placed a quantity of loose cotton. This is gradually transferred from the larger to the smaller compartment, by means of a pair of fine tweezers, without causing the alcohol to overflow.

The absorption of gases by charcoal is readily shown in the manner illustrated in Fig. 4. A glass tube, open at both ends, is dipped in mercury contained in the bottom of the tank. A cork is fitted to the upper end of the tube. Carbonic acid is poured into the tube, then a piece of freshly heated charcoal is dropped in, and the cork is instantly replaced. The charcoal absorbs the gas rapidly, creating a partial vacuum, which causes the mercury to rise in the tube to a considerable height.

In Fig. 5 is shown a tank containing four liquids of different densities, the densities decreasing from the bottom upward. This is simply the well known experiment of the "vial of four elements." The liquids are mercury, a saturated solution of carbonate of potash in water, colored alcohol, and kerosene oil. This simple experiment is very interesting when performed in the usual way; but when it is projected upon the screen, the struggle of the different liquids to regain equilibrium, after having been thoroughly stirred up, is striking.

A Large Organ.

A correspondent of *La Science en Famille* states that in the Protestant church at Libau (Russia) there is an organ which occupies the whole width of the church, about 60 feet, and which has 131 registers, 8,000 pipes, and 14 bellows of large size. It has 4 harpischords and one pedal. The largest pipe is formed of planks 3 inches thick and 31 feet in length, and has a section of 7 square inches, and weighs 1,540 pounds. Besides the 131 registers, there are 21 accessory stops that permit of combining various parts of the instrument without having direct recourse to the registers. By a special pneumatic combination, the organist can couple the four harpischords and obtain surprising results. For the sake of comparison, the following large instruments of this kind may be cited: Organ of the Cathedral of Riga, 125 registers; Garden City Cathedral 120; St. Albert Hall, London, 100; Cathedral of Ulm 100; St. George's Hall, Liverpool, 100; Notre Dame, Paris, 90; Boston Cathedral 86; Cathedral of Schwerin 85; St. Nicholas Church, Leipzig, 85; Cologne Cathedral 42.

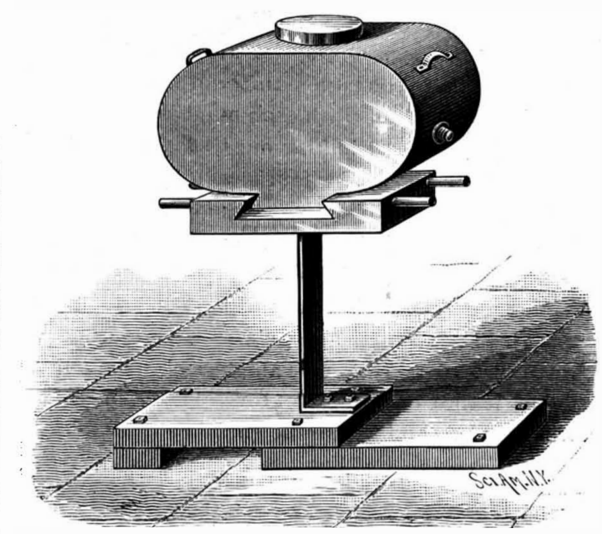
The New St. Clair Tunnel.

The St. Clair tunnel from Port Huron to Sarnia is making fair progress. Instead of driving from intermediate shafts, work has been started at the portals, which are now just being dug out. The total length from portal to portal is about 4,620 feet, of which 2,400 feet is under the river, which is here 42 feet deep. The distance of the roof of the tunnel below the bed of the river averages about 25 feet. The material is blue tenacious clay throughout, plastic and putty-like in consistency. About 150 men are now at work. It does not appear likely that any considerable trouble will arise from water, although there may from gas, which at points is encountered under high pressure, but small volume, so that it soon exhausts itself. The adopted section is a circle of 20 feet 4 inches outside, 19 feet 10 inches inside the clear, the lining being cast iron segments 2 inches thick, 6 inch flanges, 18 inches wide; 14 segments and a key-piece about 10 × 18 inches completing the circle. A cast steel shield, 15 feet × 21 feet 4 inches, is driven in front by a hydraulic pressure of 3,000 tons from twenty-four jacks, 10 in. × 26 in. Two 30 H. P. Roots blowers are to supply air, two 50 H. P. Lidgerwood engines do the hoisting, two 100-light incandescent light plants supply illumination, and the plant generally is on a very liberal and adequate scale.

The grades into and out of the tunnel are 2 per cent for about 3,000 feet at each end. The cost of the tunnel is likely to be high, say $2,250,000, the metal lining being very expensive; 800 tons of bolts alone will be required. The material is so fluid that it is practically impossible to make an open cut even 60 feet deep for the approaches.—*Engineering News.*

AN IMPROVED CHURN.

The accompanying illustration represents a light and simple form of churn, designed to be very effective in operation, for the invention of which a caveat has recently been filed in the Patent Office, by Mr. Robert

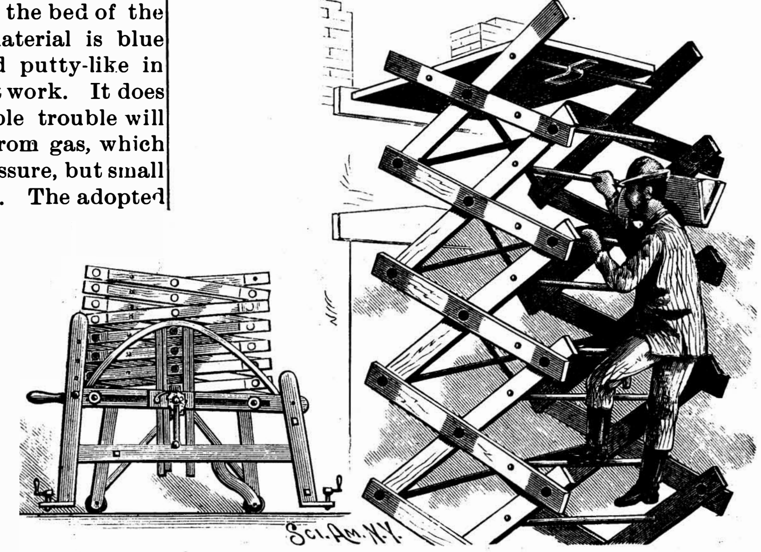


CAMPBELL'S CHURN.

Campbell, of Mancelona, Mich. The base is made in two parts for convenience in shipping, and on the base is secured an arm carrying at right angles a vertical spring plate, to the upper end of which is attached a support for the cream-holding vessel. This support has handles at each end, and has a central dovetailed groove in which fits a dovetail formed on the under side of the cream-holding vessel, the latter being preferably made in the shape of a boiler placed on one side, a cap screwing on the top opening, for filling the vessel and removing the butter, while there is an opening near the bottom for drawing off the buttermilk. The churning is performed by pulling either of the handles in one direction to bend the spring plate, on letting go of which the plate rebounds and the cream in the vessel receives a concussion, this operation being repeated as often as necessary until the butter is made.

AN IMPROVED EXTENSION LADDER.

An extension ladder which may be quickly and conveniently elevated and inclined toward a given object, and which can be readily transported from place to place, has been patented by Mr. Simeon Piche, of 305 West Superior Street, Duluth, Minn., and is illustrated herewith, the small view being a side elevation of the ladder when folded down for transportation. The device has two stationary sides, consisting of inclined uprights united by a crossbar, the longer upright having on its inner face a longitudinal bracket provided with a series of apertures. Near the upper end of the other upright is pivoted a lever arm, the handle end of which rests in the bracket on the longer upright, and is adapted to reciprocate, or to be held at any desired point. Upon the upper edge of each of the lever arms a curved beam is secured, the ends of the beam being attached to the lever arms within the standards, and from these curved beams, at each side of their center, a standard is downwardly projected, plates being secured upon these standards to constitute ways upon which rack-bars are adapted to slide. A transverse shaft through

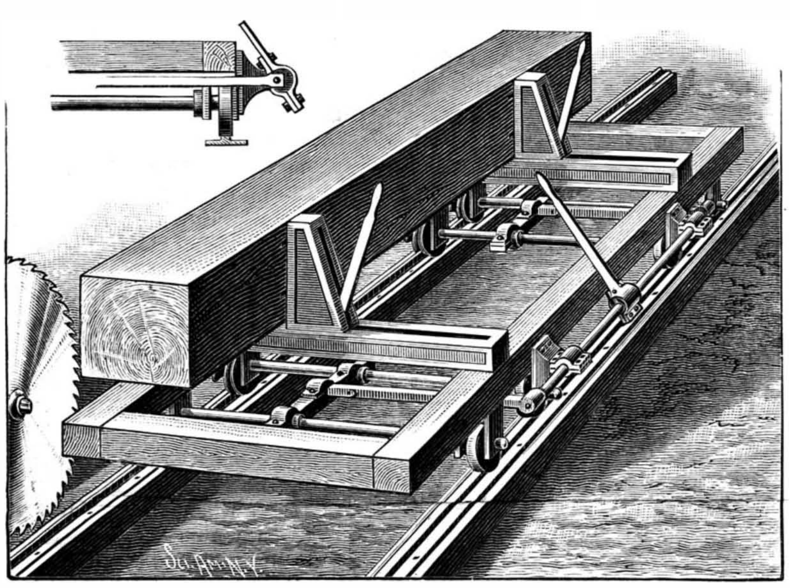


PICHE'S PORTABLE EXTENSION LADDER.

the center of the lever arms has a crank arm at each end for rotating the shaft, upon which are pinions, one pinion adapted to engage and reciprocate the approaching racks on each side of the ladder frame, while upon one extremity of the shaft a ratchet wheel is secured, adapted to be engaged by a pawl pivoted to the outer face of one of the lever arms. The ladder proper is made up of a series of rectangular frames arranged to form lazy-tongs, each frame having near its forward ends a round, the rounds being in vertical alignment when the ladder is extended or elevated. The ladder is elevated by means of the crank handles on the transverse shaft, when the sliding rack operates to extend the several sets of lazy-tongs, the lever arms affording the means of inclining the entire ladder to the rear as far as desired. A platform is usually provided for the top of the ladder, the platform having hooks adapted to encircle one of the upper rounds. From the lower set of lazy-tongs are projected legs, provided with wheels, these legs being drawn from the ground when the ladder is elevated, and the ladder then resting upon its fixed frame, but when the ladder is folded down these legs assume an essentially perpendicular position, and form supports whereby the ladder may be guided on its wheels in any direction.

OFFSET MECHANISM FOR SAWMILL CARRIAGES.

A simple and conveniently manipulated device, whereby the log frame and mechanism carried thereby on sawmill carriages may be shifted bodily in a line at right angles to the line of travel by the carriage, preparatory to "jigging back," is illustrated herewith, and has been patented by Mr. George Rosenberg, of Muskegon, Mich. The carriage is supported upon axles journaled in hangers, and upon the axles are keyed collars, each pair of axles being connected by a cross bar, the ends of the bars encircling the axles between the collars. Upon the side of the longitudinal beam of the carriage farthest from the saw a rock shaft is journaled, an eccentric or short crank being formed on each end of the rock shaft, the eccentric faces being turned down when the carriage is carried back for a cut. The rock shaft is manipulated by a lever secured thereto at or near its center. A short rod is passed centrally through the cross bars, uniting each pair of axles, the rod being provided at each side of the cross bars with a lock nut, and having a slot in the end facing the rock shaft, with which the rod is united by a link pivoted in the slotted end of the rod, the outer end having an integral sleeve in which the eccentric surface of the rock shaft is held to revolve. When the carriage is to be jigged back, the lever manipulating the rock shaft is moved from the saw, causing a tension to be exerted on the cross bar held between the central collars on the axles, so that the frame and its appurtenances are drawn away from the saw, while to throw the log into contact with the saw, the lever on the rock shaft is turned toward the saw, as shown in the illustration. The rock shaft may, if desired, be journaled inside the carriage frame, either above or below the axle.



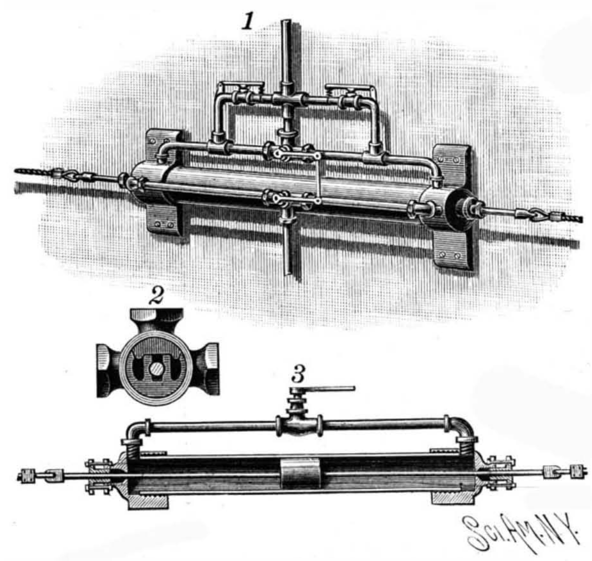
ROSENBERG'S OFFSET FOR SAWMILL CARRIAGES.

A Great Steel Plant.

The steel plant of the Phœnix Iron Company, of Philadelphia, which has been in course of erection for the last four months, is now reported as completed. The engines weigh 370,000 pounds, and the roll train weighs 400,000 pounds. This is the largest plant in the country, not excepting that at Pottsville. The engines have a capacity of 2,000 pounds pressure, and the plant is expected to turn out steel suitable for armoring cruisers for the government and for making steel guns of any caliber.

AN IMPROVED STEAM STEERING-GEAR.

The steam steering-gear herewith illustrated, which has been patented by Mr. Frank B. Turner, of Portland, Oregon, consists in a long steam cylinder, with a piston whose rods reach through opposite ends of the cylinder, and are connected with the tiller ropes, Fig. 1 showing a side elevation, Fig. 2 a transverse section of one of the valves, and Fig. 3 a longitudinal section. The pipes entering opposite ends of the cylinder, as shown in Fig. 3, communicate with a central three-way valve, one of whose openings receives the steam supply-pipe. Similar pipes, also entering opposite ends of the cylinder, are likewise connected with a similar three-way valve, which receives the exhaust pipe, T's in the latter pipes communicating with safety valves arranged to resist the highest pressure the cylinder is obliged to bear in the regular working of the apparatus. The arms of the exhaust and live steam valves are connected by a link, so that the two valves will be moved simultaneously, and when steam is admitted into either end of the cylinder by the live steam valve, it is exhausted from the other end. By admitting steam to both ends of the cylinder at the same time, and closing it in, the piston will be held in any desired position along the length of the cylinder, the exhaust closing before the feed-valve, which may be left open just enough to give the required pressure on both ends.



TURNER'S STEAM STEERING-GEAR.

Eels that Scale Precipices.

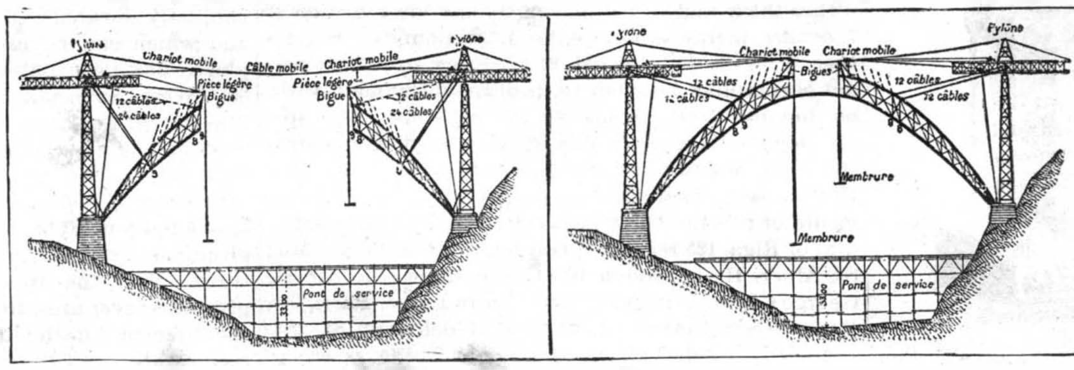
One of the most novel sights in the spring of the year, at the rocks of the Willamette Falls, is the swarms of gyrating eels. They are friskiness itself, and show a low order of intelligence. If you put your hand in the water over the eels, or spit on it, instantly they are gone. But poke a stick down among the snaky things, and they do not notice it. The sense of smell seems to be their main guard against danger. Like salmon, they do their level best to dart up the rocks in order to ascend the river, and with good success. Says a fisherman:

"I have seen as many as a hundred bushels of eels hanging on the rocks at one time by the suckers of the mouth. They would wiggle and flutter their tails, and by the momentum thus obtained, letting go with their suckers, jump up about six inches higher. I caught about forty barrels last season that I salted and sold to the Columbia fishermen for bait. I picked them off the rocks with a fish hook tied to a pole. I started at the bottom row of hanging eels, and would silently pick off barrel after barrel. The upper rows hadn't sense enough to perceive the enemy. I have caught eels in the headwaters of the Santiam, in the Cascade Mountains. Suppose they had swum up from the Willamette."—*Oregon City Courier.*

MANY a man has ruined his eyesight by sitting in the bar room looking for work.

THE GARABIT VIADUCT.

We have already spoken several times of the Garabit viaduct—that colossal work which does so much honor to French engineers—and we have given the dimensions and principal arrangements of it, and have described the placing of a part of the superstructure. We shall now complete what we have already published by a description of the placing in position of the large central arch and the process employed for mounting this huge mass. We shall give a few details in regard to this point, as well as to the tests that have been made this year, and which are borrowed from the interesting book in which the lamented Beyer has given all the calculations relating to the viaduct.



Figs. 1 and 2.—ANCHORAGE OF THE ARCH AND SUPERSTRUCTURE OF THE GARABIT VIADUCT.

The central arch of the viaduct, constructed by Mr. Eiffel, is, as is well known, of 540 feet span and rests upon two large piers, the metallic part of which is 195 feet in height. The total weight of this arch is 2,608,540 pounds.

The piers were first constructed, and then the two lateral parts of the superstructure were set up upon mounds of earth arranged as platforms. Next, these parts were swung into position on the large piers, and were made to project about 70 feet on the side toward the arch. Each, thus placed, was held very firmly by means of 28 steel wire cables fixed to the rear end and anchored to the abutments of the approaches.

This done, two scaffolds were erected in front of the

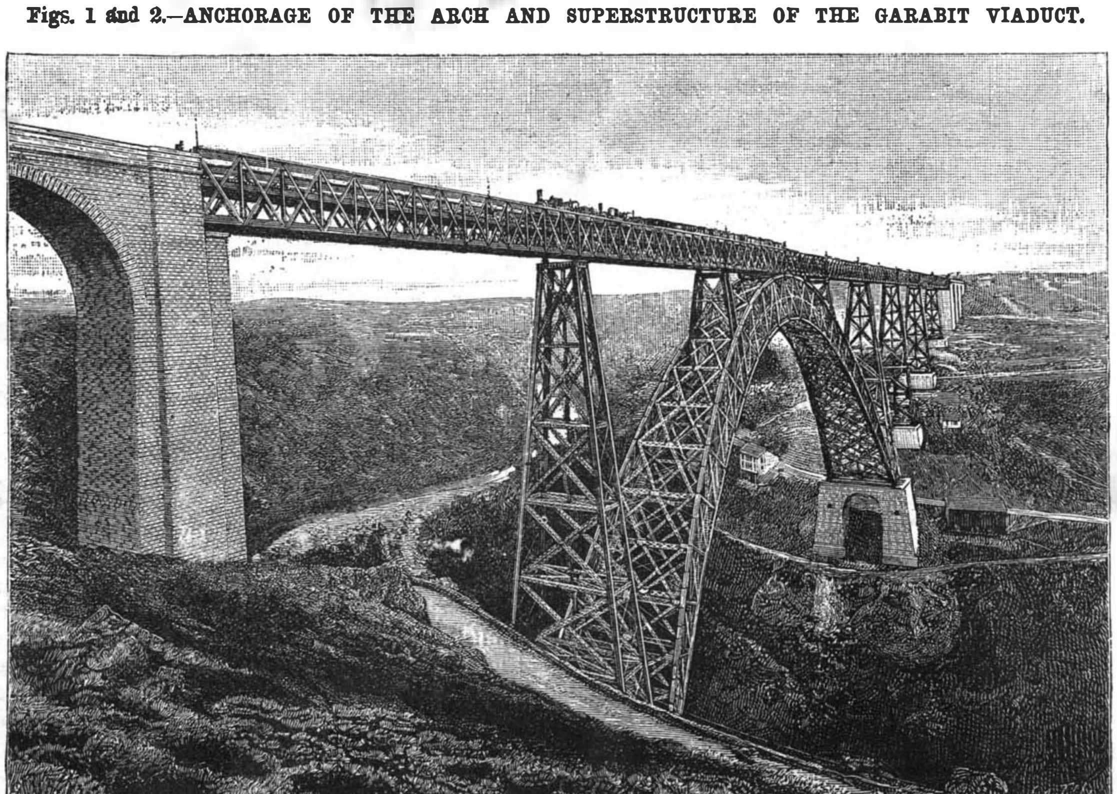


Fig. 3.—TESTING THE VIADUCT UNDER THE WEIGHT OF A 405 TON TRAIN.

large piers, and the upper part of these, in the form of an arch, was so arranged as to follow accurately the curve of the inner surface of the proposed arch (that is to say, the intrados) at its springing. Upon these centers were placed the corresponding metallic pieces, and, after this part of the arch had been constructed, it was connected by means of twenty steel cables with the straight superstructure to the right. From this moment, it was possible to begin the mounting of the projecting arch according to the method previously applied by Mr. Eiffel to the Douro bridge. The operation of joining the pieces proceeded by degrees, care being taken, when the weight of the overhanging part became too great, to put a new series of anchoring cables in position, connecting the pier extremity with the upper superstructure. Figs. 1 and 2 well show in what the process consists. The placing of these cables permitted of raising or lowering the parts of the arch in process of being mounted, in every stage of advancement. The special arrangements made to this effect were as follows: The ends of the cables rested upon iron girders through the intermedium of wedges that could be disengaged by means of hydraulic presses. It was then easy to give each cable the desired tension and length. The cables, as a whole, really constituted a totalizing apparatus that permitted of moving million-pound masses by means of a series of successive stresses never exceeding 15 tons.

In fact, Mr. Eiffel had found by preliminary experiment that an increase of half an inch in the length of a cable corresponds to an increase of 2,200 pounds in its tension. By introducing a half-inch wedge under the end of one of the cables, the neighboring cables were decreased in tension 2,200 pounds, distributed over the other cables as a whole. These latter, therefore, were contracted to an extent corresponding to such diminution of tension, and they consequently raised the arch. The totalisation of the slight liftings due to the repetition of this maneuver on each of the cables finally effected a general lifting of four inches. When it was desired to lower the arch, the operation was just the contrary, that is to say, the wedges were removed in succession. A mastery over the position of the projecting parts was had at every instant.

After the two halves of the arch had been brought so close together that there was room only for the insertion of the center piece, the process of keying was begun. As the two halves had, during the mounting, been held a little above their final position, there was a few inches more space between them than was necessary for the insertion of the key, and it was only necessary to remove progressively a few wedges to bring the pieces gradually into complete contact.

The closing of the intrados was effected on the 20th of April, 1884, and haste was at once made to ease all the cables in order to prevent a fall in the temperature from producing an increase of abnormal stresses, either upon the cables or the arch itself. This quick easement was effected by means of sand boxes that care had been taken to interpose between the superstructures and the large piers.

On the 25th of April, the few stanchions and uprights that remained to be put in place at the top of the arch were inserted, and on the 26th all was ready for mounting the key of the extrados. This was hoisted at 3 o'clock, and at 7 o'clock in the evening it was definitively placed. It was only necessary to use hammers to cause it to gradually enter the space that it was to fill.

The operation succeeded with a precision that may be qualified as mathematical, seeing the large dimensions of the work and the circumstances under which so delicate a mounting was effected.

It only remains to say a word regarding the tests that were made last April, before the viaduct was opened for travel. These tests were of two kinds. In one the loads remained stationary, in the other they were rolling. The test loads consisted of a 75 ton locomotive hauling 15 ton cars, and the results obtained are worthy of being cited, as they demonstrate the surprising fixedness of the structure.

The arch, loaded for its entire length by a train of 22 cars (Fig. 3), exhibited under this enormous weight of 405 tons a deflection of 0·27 inch. The same train, placed upon one of the halves of the arch, produced a deflection at the key of but 0·15 inch. Finally, under the action of the rolling weight, the deflection was but 0·46 inch.

These figures are significant. They constitute, perhaps, for people who are informed, the finest eulogy that can be addressed to the eminent constructor, Mr. Eiffel, who, after the Garabit viaduct, will astonish the world with his 984 foot tower.—*La Nature.*

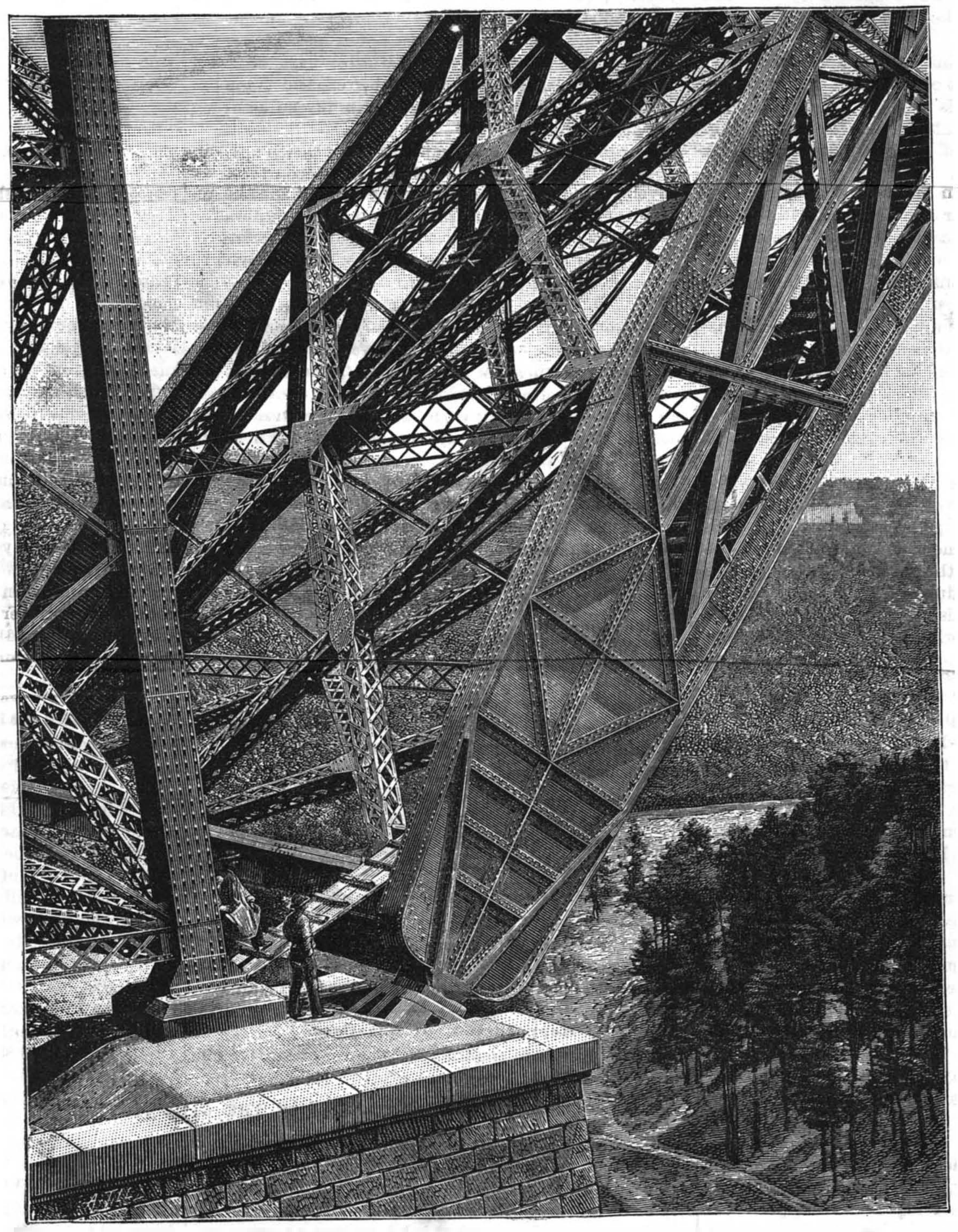


Fig. 4.—SPRINGING OF THE ARCH OF THE GARABIT VIADUCT.

Printing of Photographs in Colors.

Mr. Fred. E. Ives lately read before the Franklin Institute a paper on heliochromy, which was an addition to a communication made to the Institute last February, and in which he explained his method of producing photographs in natural colors.

According to the *Ledger* report, Mr. Ives said: "I assumed that we might counterfeit all the colors of nature in a photographic picture by making each ray of simple color select automatically, in the operation of the picture-making process, such a type color or mixture of type colors as will counterfeit it to the eye, and showed how this can be accomplished by means of photographic plates made sensitive to all colors, and exposed through compound light filters, which are suitably adjusted by experiment upon the spectrum itself."

He quoted from a recently published work on color to show that his plan of operation was in accordance with what is now recognized as the true theory of the nature of light and color sensation. Continuing, he said: "Although I originally worked out my process on the simple plan of making each primary ray of spectrum color select from and combine three pigment colors to counterfeit it, it becomes evident that in accomplishing this I might have produced one negative by the action of solar rays nearly in proportion as they excite the 'red nerve fibrils' of the eye, another in proportion as they excite the 'green fibrils,' and another in proportion as they excite the 'blue fibrils.' I did not do this at once, but after experimenting with several sets of reproduction pigments, adjusting color screens so that I could make the process counterfeit the spectrum with either set of pigments. I finally adopted reproduction colors which call for negatives of the spectrum showing curves of intensity approximating to the curves in Maxwell's diagram, illustrating the action of the spectrum upon the different sets of nerve fibrils. These colors are certain shades of red, green, and blue light, or their complementary colors in pigments, which approximate to Prussian blue, magenta red and aniline yellow, the first two of so light a shade that it is necessary to superimpose one upon the other to obtain a full violet blue, the blue upon the yellow to obtain green, and the magenta upon yellow to obtain red.

Concluding, he said: "Admitting the theoretical soundness of my mode of procedure, which I believe I have fairly demonstrated, there remains only the question of practicability and commercial value to be considered. The process is practicable if the same operations repeated in the same manner can be relied upon to produce pictures which counterfeit the light and shade and color of all objects. Three subjects which I shall show to-night, a delicate oil painting, a brilliant Prang chromo, and a beautiful sea shell, were made with the same light, same camera, same preparation of sensitive plates, same set of color screens, same relative exposures, and same development. They show a very great variety of colors, mostly compound in the painting and chromo, but pure spectrum colors in the sea shell, yet the colors of all are alike faithfully counterfeited to the eye."

The pictures thrown upon the screen by Mr. Ives seemed to fully confirm his claims as to the efficiency of his mode of reproducing the colors in a picture or in nature.

Mr. Ives also exhibited a camera contrived by himself, in which the lenses and color screens are adjusted so as to produce simultaneously the three negatives required by the above mentioned heliochromic process.

The New Railway Bridge at New London, Conn.

A large swing bridge, with two spans of 250 ft. each, is to be erected over the Thames river at Winthrops Point, near New London, to carry the lines of the New York, Providence, and Boston Railroad. The principal peculiarity about the work is the method by which the three deep foundations are to be sunk, the total depth of mud and water to be passed through being 130 ft., 128 ft., and 103 ft. in the different cases. To avoid the expense of the pneumatic system the following plan has been adopted: An immense timber crib in one case, 71 ft. square, is to be sunk to the bottom of the river, and the mud dredged out inside it to the depth of 20 ft. In the space thus prepared piles will be driven. The spaces round the heads of the piles will be filled with concrete, and the masonry of the piers will be built on this.

Christmas Trees.

New York buys thousands of Christmas trees in Maine during the first half of December, and large crews of men are employed in various parts of the State cutting the big town's supply. A Christmas tree is valued first according to its symmetry, second as to its size. The ideal tree is anywhere from ten to fifteen feet in height, with stout branches at regular intervals. Some trees have too few branches, while others have so many as to hide the articles hung upon them. Whole steamer loads of Christmas trees, cut in the western part of the State, are shipped from Portland to New York, and one man in Camden, on Penobscot Bay, is getting out 30,000 trees for the metropolitan market.

The Working Steam Engineer.

While it is true that in every line of manual labor, whether skilled or unskilled, genius and thought are recognizable, and the service of one man is enhanced beyond that of another, still the divergence from the plane of a general average, in most trades, is so slight as to make a standard of wages possible. The working steam engineer is an exception to this condition.

The street laborer may, by care and thoughtfulness, make himself of more intrinsic value to his employer, yet in a general sense his superiority is not materially felt, and a standard of wages for him is possible. Thus, also, in those branches of skilled employment where the labor becomes of a routine character, and where slight variation of subject is necessary, the same conditions exist.

This being the case, it is easy for combinations of tradesmen or labor to establish, by general consent, a code of wages for the guidance of its members. The further removed from that class of labor where bone and muscle are the only elements necessary for success, the more difficult it is to set any standard by which to estimate excellence or make an equalization of payment.

The medical profession may set a standard of payment, the mere physical act of making a visit being the basis from which payment is estimated; but if the absolute service rendered a patient were to enter into a discussion, the question of remuneration would be somewhat difficult to settle.

The mere fact that a man enters a shop and there toils for the allotted number of hours makes it possible to settle his wages by the standard of another man performing a like service; but when the service rendered is the product of thought and study, when the results of mental activity are thrown into the balance against muscular exertion, then the reward can only be measured by the profit given to the employer.

The greater and more varied the knowledge necessary to perform a certain line of duty, the greater the extreme from the inferior to superior talents; hence in proportion is the service rendered increased or decreased in value.

One of the leading English steamship lines, while having one established code of payment for its chief engineers, has a bonus fund, payable monthly to each chief engineer, which payment is determined by the success of the engineer and the absence of neglect on his part in the fulfilling of his duties. Thus each engineer becomes a competitor for this extra emolument. As the business of steam engineering takes to itself certain qualities of the professions, it becomes necessary to gauge the emoluments by the same standard—that of especial fitness. To set a standard by which all attorneys were to be paid would at once close the doors to the chamber eminence, and no member of the legal profession would consider the incentive sufficient to warrant him in putting forth the energy necessary to advance beyond mediocrity.

In the employment of men, that class of labor that is purely mental commands higher price than does that class where only physical strength is wanted. One brain may design a steam engine, but more than one is necessary to build it. Hence, then, among brain workers, experience and originality are factors of success. Neither can we gauge a man's worth—commercially speaking—by lapse of time, for one man with frosty locks may have traveled a shorter distance along the highway of observation than his neighbor with half his years.

Certain qualities are always necessary to enable any man to succeed in his vocation, and a man's advancement above his competitor depends upon the magnitude of these qualities.

The working steam engineer is a man in whom must be found executive ability, and in proportion to his ability to execute is his service as an engineer enhanced.

Twin sister to executive ability is self-reliance. The working steam engineer must be endowed with keen perspicuity, so that he may be able to absorb generalities at a glance, and sufficient executive powers to carry out details with correctness and precision. One of the best and most reliable second engineers that we ever met—in marine service—was one of the most inglorious failures as a chief. He lacked completely the attribute necessary to execute. He was so devoid of self-reliance as to hesitate to back out into the stream at the beginning of a new trip any steamer upon which he was chief engineer. A thorough mechanic, and of more than ordinary education, he was in every way a first class man to carry out the details under the general planning of another.

Originality is the cradle in which eminence is nursed, for originality lifts men from the beaten track of the past into unexplored fields, giving the world new productions in science, literature, and art. To succeed, the engineer must be original, and his performing a certain act must not be because some one else did it, but because from his own observation he knows it to be proper and correct.

Not only must the engineer be able to do for himself, but he must plan for others to do; he must be able to direct generalities and execute details; in fact, he must combine the practical and scientific to such an extent as to make it difficult to establish a general standard of payment for his services.—*American Engineer.*

How to Invest Wisely.

The remittance of $3 for one year's subscription to the SCIENTIFIC AMERICAN for the coming year will be a good investment; but there is one that will pay better, and that is to send $7 and receive both the SCIENTIFIC AMERICAN and SCIENTIFIC AMERICAN SUPPLEMENT during 1889; and yet another that will pay still better, and that is to remit $9 and have the ARCHITECT AND BUILDERS EDITION of the SCIENTIFIC AMERICAN included with the above. With the weekly receipt of the two weekly papers, and the monthly ARCHITECT AND BUILDER, the subscriber will have placed before him all the scientific, engineering, and mechanical news of the day, and enough architectural designs and building news to meet the ordinary wants of a person contemplating building for himself, or a contractor who makes estimates of the cost of construction for others.

Energy and Vision.

In a paper on this subject read before the National Academy of Sciences, Prof. S. P. Langley summarizes the paper as follows:

The time required for the distinct perception of an excessively faint light is about one-half second. A relatively very long time is, however, needed for the recovery of sensitiveness after exposure to a bright light, and the time demanded for this restoration of complete visual power appears to be greatest when the light to be perceived is of a violet color.

The visual effect produced by any given, constant amount of energy varies enormously, according to the color of the light in question. It varies considerably between eyes which may ordinarily be called normal ones, but an average gives the following proportionate result for seven points in the normal spectrum, whose wave lengths correspond approximately with those of the ordinary color divisions, where unity is the amount of energy (about $\frac{1}{1000}$ erg) required to make us see light in the crimson of the spectrum near A, and where the six preceding wave lengths given correspond approximately to the six colors—violet, blue, green, yellow, orange, red.

Color.	Violet.	Blue.	Green.
Wave length,	μ·40	μ·47	μ·53
Luminosity, (Visual effect.)	1,600	62,000	100,000

Color.	Yellow.	Orange.	Red.	Crimson.
Wave length,	μ·58	μ·60	μ·65	μ·75
Luminosity, (Visual effect.)	28,000	14,000	1,200	1

Since we can recognize color still deeper than this crimson, it appears that the same amount of energy may produce *at least* 100,000 times the visual effect in one color of the spectrum that it does in another, and that the *vis viva* of the waves whose length is 0^{μ}·75, arrested by the ordinary retina, represents work done in giving rise to the sensation of crimson light of 0·0000000000003 horse power, or about 0·001 of an erg, while the sensation of green can be produced by 0·000000,01 of an erg.

Reproduction of Negatives.

It very often happens that just the very negative one wants for a special occasion or print is either broken or mislaid, much to the annoyance of the serenely unruffled temper of the possessor, more especially if it happens to be a favorite one or if a copy is wanted as a great favor. It is not always convenient to copy a print, supposing you have one from a broken or cracked negative, and every one is the possessor of a copying camera, even of the simplest kind, so that an easy way, if it be an old or an odd one, of reproducing a negative from a print without a camera may prove useful to many who have not all the appliances at hand to do this in the orthodox improved manner.

The print must be an unmounted one, or be dismounted, after which it must be passed through a rolling press on a steel plate, taking great care that it does not cockle, wrinkle, or crease in the process. It may then be gone over and touched up and made as perfect as possible. For the negative get a piece, if possible, of the thin albumenized paper, called long ago negative paper, but if that cannot be got easily, use the ordinary Saxe or Rives paper, the latter by preference. Prepare it by silvering on a strong bath, say of, at least, sixty grains nitrate of silver to one ounce of distilled water, the usual printing bath, in fact. When dry pass it through the rolling press in a similar way to the print, and give it as much pressure as can be given, and be especially careful that no flaw appears on the surface of the paper after it has been pressed, which latter operation, it need hardly be said, must be done in the shade or under yellow light.

The printing frame must have a plate glass, and of a size larger than the size of the print operated upon. Then place the print with the paper side to the glass, the printed side toward the operator; then place the newly prepared paper, which must of course be dry, on the face of the print, close the frame, and see that the contact between the two paper surfaces is perfect, and put as much pressure on as the frame will admit of. Print in the usual manner *through* the back of the print. The time will necessarily be longer than with a negative, or rather with most negatives. Get a good, rich, deep print, which will be negative from the positive print, and if the instructions are attended to, the negative will be as sharp as a film or glass negative, the two smooth glazed surfaces being in intimate—I had almost said optical—contact.

To finish and complete the operation, wash in a flat tray, as if a print in three or four changes of water, and do not tone the negative. The rich brown color of the silver is not only quite sufficient, but far better for printing from than if it be toned. Fix in a strong new bath of hyposulphite of soda, and when thoroughly fixed wash in the usual way, and dry between sheets of blotting paper kept flat. In all the operations be very careful to allow no fold, crack, or imperfection to appear on the resulting negative, as they show in every print taken from it afterward. If the negative is not quite satisfactory, it can now be touched up, worked upon, or improved to any extent. After being quite finished, it is well to pass it again through the press, with the same precautions as before, and then proceed to render it more transparent, durable, and useful, by varnishing. To do this properly it will be necessary to prepare the varnish some hours before it is wanted. Take any clear, transparent, negative spirit varnish—the less color it has the better; see that it is not too thick, and add in the proportion of three drops of castor oil to the ounce of varnish; give it a thorough good shake to mix the oil and varnish together—this confers toughness and elasticity to the varnish, which is invaluable for paper. To varnish the negative, place the albumen side down on a glass, and either with a flat camel hair brush, or by pouring over it, saturate the paper side of the negative first; rapidly dry without cockling, and coat the albumenized side, which takes less care, being more resistant to the penetrating action of the varnish. When *about* dry, place it in a book of clean glazed or writing paper (not printed or printing) with a weight upon it to keep it perfectly flat, and allow it to dry thoroughly, when it will be ready for use.

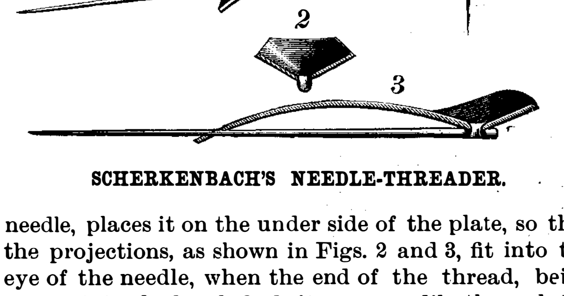
If the thin negative paper has been taken, it may be printed from either side with indifference, the grain of the paper being hardly distinguishable, and for single transfer carbon work does almost, if not quite, as well as a transferred negative with all its attendant risks not only of removal but in handling, the thin paper being much easier manipulated.—*Br. Jour. of Photo.*

A New Floating Exposition.

The Export Society of Germany has decided to build the "Floating Exhibition Palace of Germany," having raised 5,000,000 marks for the purpose. It proposes to build a ship to be called the Kaiser Wilhelm, which will be the work of German shipyards. According to plans, the ship will be 564 feet long, 65½ feet wide, and 46 feet deep. It will have four engines propelling as many screws. The material will be principally German steel. The cost of a two years' tour is estimated at 3,150,000 marks. The income from the rented space —1,000 to 1,200 marks for each booth—and from sales will be, it is thought, at least 7,260,800 marks, leaving a balance of 4,110,800, or over 2,000,000 marks annually —a pretty sum on the pages of the ledger. Emperor William it is said has promised his aid to the enterprise, and it is hoped that the vessel will sail from Hamburg on her first voyage in the spring of 1890.

A SIMPLE DEVICE FOR THREADING NEEDLES.

The accompanying illustration represents a device designed to facilitate the threading of a needle, which has been patented by Mr. August Scherkenbach, of Shakopee, Minn. The device consists of a spoon-shaped plate provided in its bowl end with a central aperture, flanked at the bottom by two projections fitting into the eye of the needle, and having at its other end a notch forming a resting place for the shank of the needle. The operator, in threading a



SCHERKENBACH'S NEEDLE-THREADER.

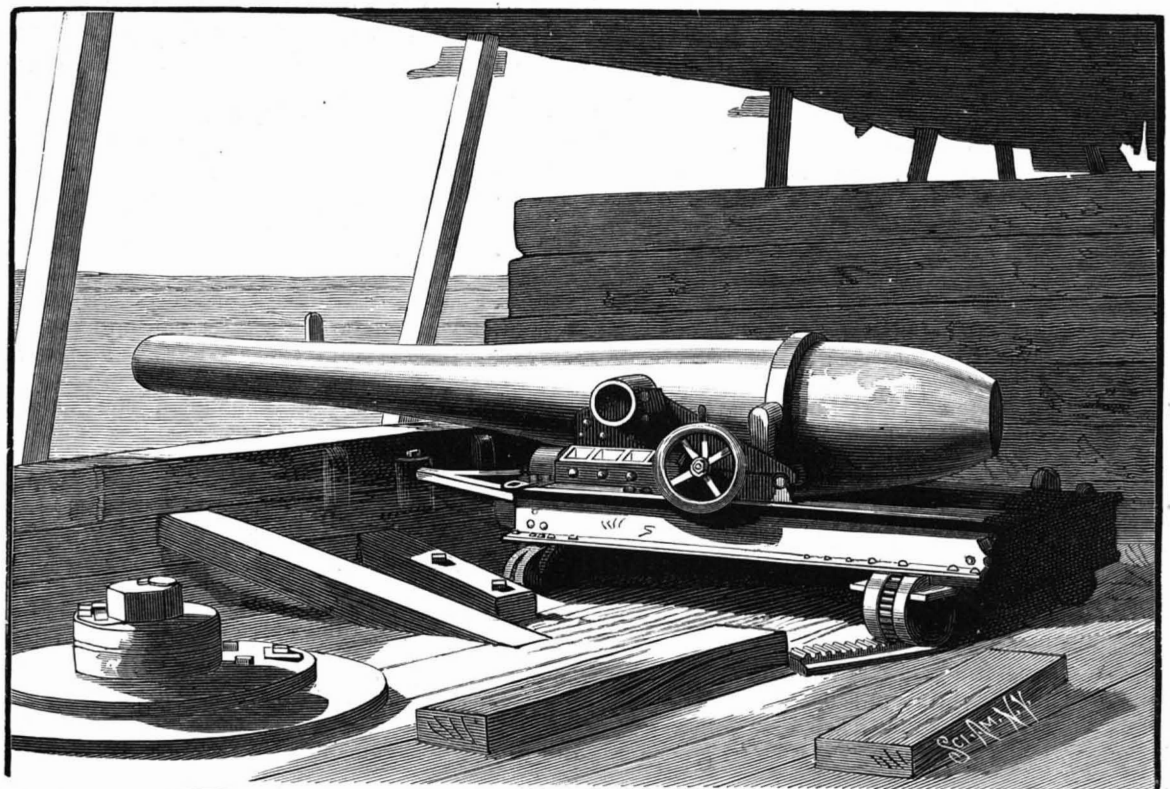
needle, places it on the under side of the plate, so that the projections, as shown in Figs. 2 and 3, fit into the eye of the needle, when the end of the thread, being passed into the bowl, finds its way readily through the central aperture and through the eye of the needle.

TEST OF THE CAST STEEL BREECH LOADING RIFLE.

As the interest of American steel manufacturers, as well as that of the public generally, has been excited by the recent test of the first Bessemer cast steel rifle cannon at Annapolis, a detailed description of the gun and its trial may be of value to our readers.

The gun was of Bessemer steel, cast solid in one piece by the Steel Casting Company, of Pittsburg. The casting took place January 11, 1888, and after the outside had been turned down and the bore rough finished by this firm, the gun was finally chambered, fine bored, and rifled at the Washington Navy Yard, where the breech block and elevating band were also fitted. The rifling and chamber reaming were beautifully done, and reflect credit on the government workmen at the Washington yard. According to ordnance nomenclature, the piece is known as a 6 inch breech loading rifle, with breech closure on the slotted screw system and obturation (gas checking) modified from the De Bange system. In this, the leak of gas through the junction of the screw breech plug and the bore of the gun is prevented by a plastic packing ring of asbestos and tallow held in an annular case of canvas. The pressure of gas in the gun on firing expands the ring and makes a tight joint. The interior profile of the bore and chamber was made to assimilate as nearly as possible to the standard built up naval gun of Bureau of Ordnance design. Its principal dimensions were:

Weight, 10,510 pounds; length, 193·5 inches; diameter across breech, 21·78 inches; diameter of bore (across lands), 6 inches; diameter of chamber, 7·50 inches; capacity, 1,400 cubic inches; twist of rifling, from 1 turn in 180 to 1 turn in 30 calibers; weight of projectile, 100 pounds; weight of powder charge (full), 48¼ pounds.



THE SIX INCH CAST STEEL BREECH LOADING RIFLE BEFORE THE TRIAL.

The projectile was the common cast iron shell, 21 inches long, 6 inches in diameter, with ogival head and rotation band of copper. This band has a slightly greater diameter than the bore of the gun, so that the gas pressure, when the gun is fired, forces the soft metal into the grooves of the rifling, and thus gives rotation to the projectile.

The powder used was manufactured by Messrs. Du Pont, and is known as brown prismatic or cocoa powder from its color. Every grain has the form of a right prism with a hexagonal base and a quarter inch hole in the axis, the object of the hole being to allow ignition in the center and thus cause the grain to burn with an increasing surface for combustion. The height of a grain is one inch, and there are about ten grains to the pound. It is the same kind of powder that is used in the regular service guns, and the charge was the same as is fired in the built-up 6 inch guns of the navy. From previous records of firings with this powder, this charge of 48¼ pounds could be depended on to give a muzzle velocity to the projectile of 2,000 feet per second, with a pressure on the walls of the gun of about 15 tons to the square inch.

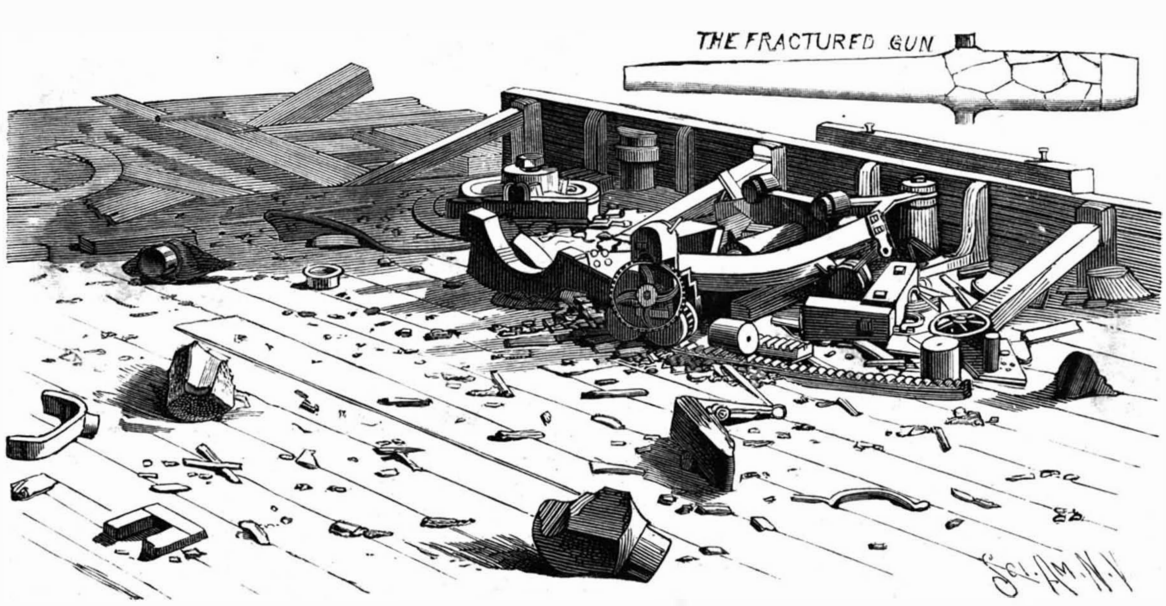
Preparatory to the test, the gun was mounted on a carriage in which the energy of recoil was absorbed by the resistance offered by water in being driven through a small orifice, while after recoil the gun was run out quickly to battery automatically by compressed air in two small reservoirs in rear. The carriage worked admirably during the trial.

To prevent accident to spectators and guns lying near by on the battery platform, a house of heavy timbers, 12 inches square, in two layers, was built over and on both sides of the gun where it lay mounted in the gun shed; besides which, bombproofs were provided near by on the grounds to the rear, from which the action of gun and carriage could be seen reflected in mirrors.

The firing trial took place on December 5, and was under the direction of Lieutenant A. M. Knight, Inspector of Ordnance in charge of the proving ground, assisted by Lieutenants Wilner and Gleaves and Ensign Dashiell. The owners of the gun were present, as well as many naval officers and representatives of the press. It was intended to fire ten rounds as rapidly as possible with full charges—the regular naval gun test—but, at the request of President Hainesworth, of the Steel Casting Co., a reduced charge of 36 pounds of powder was decided on for the first round. The gun was pointed at a thick hill of earth thrown up for such purposes. The shell was entered and run home; then came the charge in a tight fitting serge bag, and the breech was closed and primer put in. Every one took shelter in the bomb-proofs, and the 60-foot lanyard was pulled. A tremendous crash, with a shower of mud from the earth butt, followed. The gun recoiled 21¾ inches, and everything worked perfectly. This charge gave a velocity of 1,700 feet per second and a pressure of about eleven tons.

WRECK OF SHED AFTER THE EXPLOSION.

The rapid firing test of ten rounds, with full charge, was next prepared for. A shell was run in, the full charge of 48¼ pounds entered, and the breech closed. When all had taken shelter, the lock string was pulled. A terrific explosion followed. The air was filled with flying timbers and pieces of steel and a dense cloud of dust. The roof of the gun shed was wrecked, the logs were blown in every direction, and many of them were split and crushed to splinters. Pieces of the gun lay around on all sides. The wreck of building, carriage, and gun was complete. The breech was blown 130 feet to the rear, with the plug in it and the pressure gauges uninjured. The chase and muzzle were projected forward 10 feet, while the shell probably struck the butt from 15 to 20 feet from the point aimed at. When the wreck could be cleared away, it was found that the breech of the gun, from the trunnions to the rear face, had been ruptured and broken into twelve large pieces and several smaller ones. The annexed sketch will give an idea of the lines of fracture.

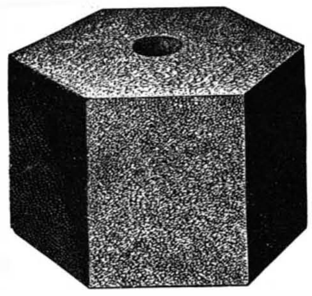


REMAINS OF GUN AFTER CLEARING AWAY THE WRECK.

The carriage was completely demolished.

On examination of the gauges which were in the breech block, a pressure of 14·1 tons to the square inch was recorded—less than the expected mean pressure of

15 tons. This is the first cast steel gun that has been tested at the proving ground. Another, of open hearth steel, by the Standard Steel Casting Co., awaits a trial, which will probably take place during the coming month.



ACTUAL SIZE ONE GRAIN POWDER.

The Brooks Underground System in Brooklyn.

The Brooks system of underground telephone conductors now being laid in Brooklyn by the New York and New Jersey Telephone Company consists in saturating the textile covering of the cables with a mixture of resin and resin oil and drawing the cables into the wrought iron pipes. The pipe is first prepared by scouring the inside sufficiently to remove the sharp edges or protuberances, and reaming the sharp ends in order that the covering of the cable will not be abraded when pulled into the pipes. Instead of using the ordinary socket or coupling, a T-coupling is used. For a pipe 2½ inches in diameter the T is provided with a 1 inch plug, and when the lengths are screwed together the plug of the T points upward. For every 500 or 1,000 feet length, or such length as may be most convenient, there is a splice box, and for the length to be pulled in there is another splice box, over which there is placed a winch. When the lengths of pipe are screwed together, the length is beaded over a wire, which is drawn from a reel as each successive length of pipe is added.

When a sufficient pulling length is formed, a few lumps of caustic lime fresh from the kilns are placed in the splice boxes, the object of which is to dry the air contained in the pipe. Every screw thread before screwing up is well covered with a mixture of white lead and linseed oil, such as is used to make an ordinary screw joint moisture-proof. The pipe is the common lap-welded wrought iron; the wire left in the pipe is for the purpose of drawing in the rope which is used for pulling in the cable.

Common resin of the heaviest quality is broken up and thrown into the caldron, and for a barrel of resin there is added a barrel of resin oil. The oil is known in the trade as "London oil" or "kidney oil." The cost of the resin is about $1.50 per barrel; the oil costs about 11 cents per gallon.

When sufficient of this mixture is placed in the caldron to cover the cable, the fire is kindled underneath, and the contents of the caldron heated to about 360° Fahrenheit.

When the mixture is heated to above the boiling point of water, 212° Fah., yellow or red bubbles begin to rise and float over the surface until the moisture is all evaporated. The heat is carried to about 360° Fah., and remains at that point until all floating bubbles cease. It takes two hours or more after the heat has reached 360° Fah. in the liquid for it to penetrate the coil of cable sufficient to drive out all moisture. When the floating bubbles cease to show themselves, the cable is ready for pulling into the pipes. In some cases fresh lime is pulverized in a mortar and introduced into each T-joint, which prevents the cable from adhering or sticking to the pipe when pulled in, and if that is not done, about a gallon of common illuminating oil, such as coal or kerosene, is put into the highest points of the pipe, and this keeps the cable from adhering to the pipe, as the resin and resin oil mixture is an exceedingly sticky substance. Two men with a winch can pull in 500 feet in 20 minutes; but with horses and without the aid of a winch, 520 feet was pulled in in Brooklyn in five minutes.

After the cable is introduced, and after the splices are made in the splice boxes, the mixture is drawn from a spigot in the caldron heated at a temperature of 400° Fah., and turned on to the splices until no more of the mixture can be introduced at that point. The splices are wrapped on the outside with a piece of canvas or coarse cloth, so that none of the splices will touch the iron of the boxes, otherwise the hot mixture will not drive away the moisture left on the splices from the hands of the splicer.

When the splices for a length of cable are made, the T-joints are unplugged, and the pipe filled with the mixture at a temperature of 360° Fah.—*Electrical World.*

GIGANTIC FOSSIL MAMMALS.

Mr. Strauch, the learned director of the museum of the St. Petersburg Academy of Sciences, has recently sent us a photograph of the celebrated mammoth which exists in the collection of that establishment. We reproduce it herewith.

The mammoth (*Elephas primigenius*) of this museum is the one whose entire carcass was found in 1799 on the

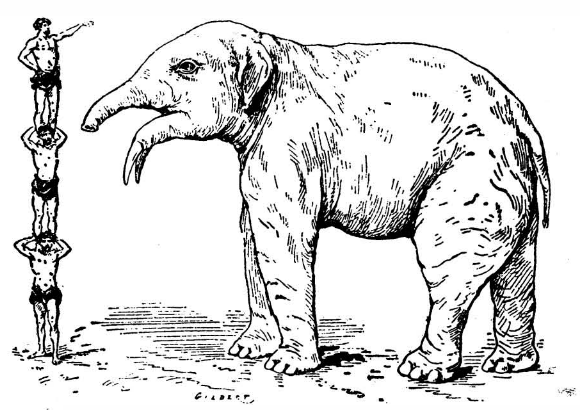


Fig. 2.

shores of the Arctic ocean near the mouth of the Lena. As seven years elapsed between its discovery and its shipment to St. Petersburg, a portion of its flesh was devoured by dogs and wild beasts. The greater portion of what remained was removed from the bones by Adams because it rendered carriage too difficult. The photograph shows that the skin and flesh have been preserved only upon the head and around the feet.

According to Tilesius, the skeleton is 11¼ ft. in height from the top of the head to the bottom of the feet. It is smaller than the skeleton of the *Elephas meridionalis* of the pliocene of Durfort, which is in the new gallery of the Paris museum. The Durfort skeleton is 12¼ ft. in height at the shoulder bones, and 13¾ from the top of the head. It is 21½ ft. long from the end of the tusks to the posterior edge of the pelvis, and 17½ ft. from the front of the head to the back of the pelvis. These dimensions much exceed those of the skeleton of the Sansan mastodon, and even surpass those of the gigantic American mastodons. The Durfort skeleton is the largest entire skeleton of a fossil mammal thus far known.

We have isolated bones that announce still more powerful animals. Thus, Mr. Haussmann, while prefect of the Seine, gave the museum a humerus of the *Elephas antiquus* found very near Paris in the quaternary of Montreuil-sous-Bois. This bone measures 4¼ feet, while that of the Durfort skeleton measures but 4 feet. We have brought from Pikermi the tibia of a dinotherium which measures 3 feet, while that of the Durfort elephant is but 2·6, and also some metacarpals that present just as great a difference.

If the proportions of the tibias, humeri, and metacarpals and total height of the skeletons were the same in the *Elephas antiquus* and the *Dinotherium giganteum* as in the Durfort *Elephas meridionalis*, it would be necessary to suppose that the *E. antiquus* attained a height of 13 feet at the shoulders and 14½ at the top of the head, and that the dinotherium reached 13 feet at the shoulders and 16 at the top of the head.

So, two human giants, one standing upon the other, would not reach the top of the head of the Durfort elephant; and three six-foot men, standing one on the shoulders of the other, would scarcely reach the top of the head of the Pikermi dinotherium.

It is natural to find the maximum of size in the Pikermi dinotherium, for this majestic creature lived, along with two species of mastodon and anchylotherium, and a giraffe and a helladotherium, at the epoch of the upper miocene; that is to say, at the moment when the animal had its apogee.

The *Elephas meridionalis* and the *E. antiquus* lived in company with hippopotami in the warm phases of the pliocene and quaternary, in which there must have existed a rich vegetation. If there is anything astonishing, it is that the mammoth of the glacial regions of Siberia, doubtless living in districts too cold for the development of an arboreal vegetation, reached the large stature exhibited by the skeleton in the St. Petersburg museum.

It will be seen from what has just been said that if we wished to classify some of the largest mammals by order of size, it would be necessary to establish the following ranks:

1. *Dinotherium giganteum* of the upper miocene of Attica.
2. *Elephas antiquus* of the quaternary of the environs of Paris.
3. *Elephas meridionalis* of the upper pliocene of Durfort.
4. *Mastodon Americanus* of the quaternary of the United States.
5. *Elephas primigenius* of the quaternary of Siberia, and the present elephants.

It is not likely that man has seen the dinotherium, but it is certain that he has come face to face with the *Elephas antiquus* and the mammoth. In order to fight them, he had but stone axes, and yet he conquered them. This allows us to believe that our ancestors of quaternary times had spirit and courage.—*La Nature.*

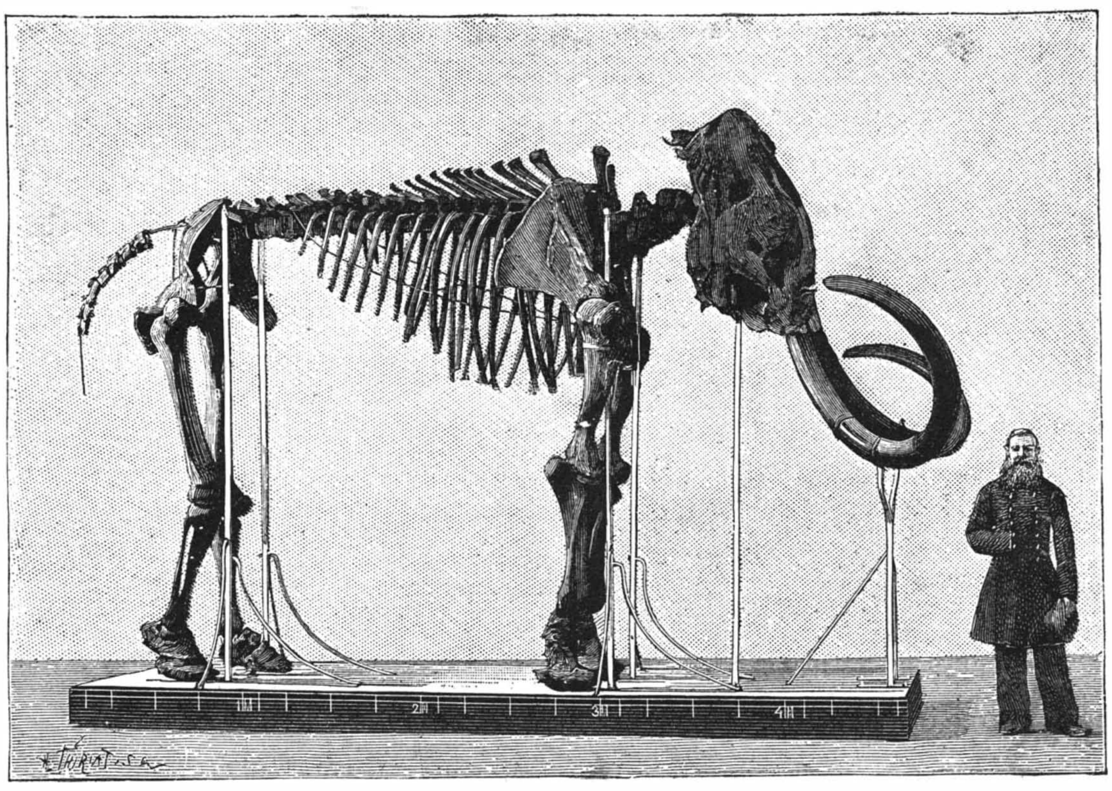


Fig. 1.—SKELETON OF THE SIBERIAN MAMMOTH.

Coal Oil and Natural Gas.

People often talk of the advantages of natural gas as a fuel without having an adequate idea of its importance. It is to-day the greatest commercial wonder of the age. No one can ponder over the following figures without being deeply impressed: It is only fifteen years ago, says the editor of *Stoves and Hardware*, published at St. Louis, that natural gas was first used as a fuel, yet to-day there is required to pipe it 27,350 miles of mains. In Pittsburg alone 500 miles supply 42,698 private houses, 40 iron mills, 37 glass works, 83 foundries and machine shops, and 422 miscellaneous industrial establishments. An idea of its value as fuel can best be obtained when the value of 7,000,000 tons of coal is estimated, as it is asserted that this amount of coal is annually displaced by natural gas. An idea of the effect a retarded production has in advancing prices can be seen in the shut-down movement in oil production.

This commenced in earnest just about a year ago, and the following is the result: In 1886, when no attempt was made to lessen production, the average run from wells was 70,666 barrels per day. In 1887, when there was less than two months' organized effort in this direction, the average daily run was 63,545 barrels. In ten months of 1887, ending November 1, when the movement was on foot in earnest, it was less than 44,000 barrels per day. The average price of certificates for the first ten months of 1887 was 64¾ cents, for the first ten months of 1888 it was 87 cents, an increase in value of 34½ per cent.

Vacuum Drying.

Mr. Beauder has applied the vacuum principle for the partial drying of fabric. The cloth is passed in full width on a horizontal cylinder, supplied with a slit through its entire length, just on the place where the cloth is allowed to pass. The cylinder is in communication with another tube, by means of which steam is introduced, which, by going out on the other side, creates a kind of vacuum in the cylinder, and by compelling the air to pass through the fabric and through the slit of the cylinder, effects a partial drying. The cloth is allowed to pass over the cylinder slowly only in order that a sufficient amount of moisture may be removed.

RECENTLY PATENTED INVENTIONS.

Engineering.

CAR UNCOUPLING DEVICE.—William O. Rutledge, Galveston, Texas. This invention covers a novel construction and arrangement of apparatus whereby the uncoupling may be quickly and readily effected from either the side or top of a car or from the locomotive, while the brakes will be automatically applied by the detachment of the brake couplings.

Agricultural.

COTTON PLANTER.—David H. Ellington, Cuthbert, Ga. This is a machine designed to open the furrow, drop the seed, and cover it in one passage over the field, in a manner to economize the seed and prevent uprooting or damage to the plants intended for full growth when the plants are chopped to a stand, while the machine may also be used advantageously for distributing fertilizers.

COTTON PICKER.—James W. Wallis, Birmingham, Ala. This is a machine having pickers for extracting cotton from the bolls, the pickers being alternately thrust into and withdrawn from the cotton plants as the machine travels along, while the machine has devices for transferring the cotton extracted by the pickers back to a suitable receptacle.

Miscellaneous.

FIRE ESCAPE.—Thomas B. Nutting, Morristown, N. J. This device is made with two detachably connected roller cages, each having a lever arm from which the body-supporting slings are suspended, an adjusting lever being also arranged in connection with the roller cages, whereby the frictional grip upon the rope may be varied by the party using the escape to increase or decrease the speed of descent.

SURGICAL KNIFE.—Justus Schmitt, Osnabrück, Germany. The knife handle is made with detachable and interlocking parts in which the blades are pivoted, the parts of the handle being locked together when the blades are closed, but free to be separated when the blades are open, while the knives may be readily taken apart and thoroughly cleaned after use.

PAPER MAKING MACHINE. — Lyman E. Smith, Mittineague, Mass. This invention provides a new and improved stuff regulator for paper machines, for regulating automatically the flow of pulp from the pulp box to the paper machine, the invention covering various novel features of construction and combinations of parts.

CASTER FRAME.—James J. Sullivan, Brooklyn, N. Y. The frame or horn is U-shaped, with apertures or bearings for the wheel axis, while the lower ends of its sides extend in front and rear of the apertures, beyond the periphery of the wheel and below the axis, so that the casters will prevent the chair or other article in which they are used from being easily tipped over.

PACKING AND BARRELING MACHINE. —Daniel F. Shoup, Ludington, Mich. This is a machine designed to pack salt, sugar, cement, and similar materials in barrels, from a pile, its parts being adjustable relatively to each other as may be required within a packing room without any change of the main shaft-supporting frame.

OIL DISTRIBUTER.—Edward Williams, Lynn, Mass. It consists of a double truncated, cone-shaped receptacle, having apertures for the flow of oil in connection with a protective covering, the distributer to be cast overboard and drawn along through the water, or to be hung from a ship's side, to allow of the escape of oil in rough weather to quiet the sea.

FELT HAT.—Frederick W. Cheetham, Hyde, Chester County, England. This invention consists in a felt hat formed of a completely felted body having an exterior or superficial veneer or covering of fine fur or wool, free from proofing or stiffening material.

SAWING ATTACHMENT. — George M. Cobb, Philadelphia, Pa. This is an improved attachment for shapers or like tools, having a reciprocating movement to saw off metallic or other bars, or to form slots, splines, etc., the attachment being also adapted to various other machines having a reciprocating movement.

BALING PRESS.—Anton Freytag, Flatonia, Texas. This is a press which can be conveniently manipulated in either a vertical or horizontal position, and readily transported in a field from stack to stack of hay, while it may be effectively and expeditiously operated by two persons.

SHIRT.—Thomas J. Holmes, Sioux City, Ia. This is an improved garment, wherein the body is made of one material, as of woolen, while the collar band, bosom, and cuffs are of another material, as of linen or cotton, the invention covering novel features of construction and combinations of parts.

LOCK.—George E. Hyatt, New York City. This is an improved combination lock especially adapted for use in connection with a letter box, the invention providing a simple and easily manipulated device whereby the use of a key will be dispensed with.

GOLD LEAF CUTTER.—James F. O'Hara and Robert H. Kaulfuss, Brooklyn, N. Y. It is a kind of knife composed of several strips with interposed blades beveled at their ends, and united by solder, the device being adapted to cut gold and other leaf into several narrow strips at a time, without waste of gold.

SOAP.—Inrank A. Packard and John D. Struble, Salina, Kansas. This is a composition designed for use in connection especially with laundry soap, and by the use of which bleaching liquids or powders and acids may be dispensed with, this soap compound being designed to effectually clean and whiten the most delicate fabric, as silk, satin, laces, etc.

THILL COUPLING.—William H. Pardee, Columbia, Dakota Ter. Two patents have been granted this inventor on this subject, the coupling being provided with a bar having an elongated right-angled end, a mortised and slotted lever being received upon the bar and adapted to bear on the inner end of the thill iron, a threaded stud being inserted in the elongated bar and having a milled nut bearing upon the slotted end of the lever. in connection with a spiral spring, one of the patents also being specifically for a simple and efficient coupling bolt fastener to prevent rattling, and which cannot become accidentally loosened.

SNOW PLOW.—Combined with a frame mounted to travel on a railroad track in front of a locomotive are section plows mounted one above another, the highest one held sightly in advance of the one just below, and designed to remove the top layer of snow, steam being used to heat the plow sections, and thus aid the latter in readily entering hard-packed snow.

FINGER RING.—David Kutner, Brooklyn, N. Y. The ring is formed with a gem box and surrounding flange having screw sockets, in combination with small screw clamps for holding the setting in the gem box in such way that it may be readily removed and another put in its place, the invention being also applicable for brooches, lockets, etc.

NEW BOOKS AND PUBLICATIONS.

KRUPP AND DE BANGE. By E. Mouthaye. New York: Thomas Prosser & Son.

ALFRED KRUPP. By K. W. and O. E. Michaelis. New York: Thomas Prosser & Son.

It is perhaps but natural that the New York firm which has for years been the representative in this country of the famous steel works at Essen should feel sufficient admiration for their founders and proprietors to become the publishers of these monograms. The comparison of the Krupp and De Bange systems of heavy guns is made by a captain on the Belgian general staff, and, although it contains much matter of interest, it is evident that such comparisons have yet to be carried much farther than they have yet been to reach judgments that will be entirely conclusive. The sketch of the life and work of Alfred Krupp is translated from the German of Victor Niemeyer.

THE ELECTRIC MOTOR AND ITS APPLICATIONS. By Thomas Commerford Martin and Joseph Wetzler. New York: W. J. Johnston. Quarto. Pp. 282. Price $3.

The design has been in this work to treat the modern motor with the utmost fullness possible, the contents of the book being largely based upon articles that have appeared within the past two or three years in an electrical journal of which the authors are editors. The book is profusely illustrated, and the typography is excellent. Among the systems treated of with most thoroughness may be mentioned the Daft, the Sprague, the Field, and the Van Depoele, for a prolonged examination of which the authors have had special facilities.

The Pope Manufacturing Company, of Boston, has issued the Columbia Bicycle Calendar and Stand, a convenient little memorandum pad suitable to occupy any vacant space on a desk. The pad is well filled with quotations designed to be of especial interest to the bicycler.

Received.

THE CHEMISTS' AND DRUGGISTS' DIARY, 1889. Published by the *Chemist and Druggist*, London, Eng., and presented to every subscriber.

PREPARING FOR INDICATION; or, practical hints resulting from twenty-three years' experience with the steam engine indicator. By Robert Grimshaw. New York: Practical Publishing Company.

STEAM HEATING. By Robert Briggs. New York: D. Van Nostrand.

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.

(44) D. J.—Wood is not petrified by any artificial treatment.

(45) J. V. B. writes: A coating varying in color from dark brown to gray forms on the zinc plates of a bichromate of potash battery. Zincs are best quality rolled zinc, well amalgamated and 6×4×¼ inch. Carbons are electric light carbons, with copper removed by nitric acid. How can such accumulation be prevented, as the battery is much weaker after first using? A. A simple bichromate battery is quickly exhausted; the zinc also is attacked by the chromic acid. For constant current you need a porous cup for the carbons, with the bichromate solution contained in it, with dilute sulphuric acid in the large cup. A porous cup combination will overcome your trouble.

(46) C. O. M.—The following is a gear table for 11-thread feed screw. You may interpolate for any required thread by dividing teeth in spindle gear by the number of threads on feed screw and multiply the quotient by number of thread required. The product will be the number of teeth in the screw gear. Use any other gear in the list for transfer, or two gears of the same size to change the motion.

	Screw gear.	Spindle gear.
For 10 threads	40	44
11 "	44	44
12 "	48	44
14 "	56	44
16 "	64	44
18 "	72	44
20 "	80	44
24 "	96	44
30 "	90	33
40 "	80	22
50 "	100	22
60 "	120	22
120 "	240	22

(47) F. R. C. asks: 1. Will a boiler 20 feet long with 2 flues 14 inches in diameter consume more fuel than a tubular boiler of the same capacity per horse power, using coal or wood? A. The economy of a boiler can only be known from observations of the amount of waste heat radiating from the brickwork, the exposed part of the boiler, and, the most important of all, the temperature of the gases going up the chimney. Any form of boiler that is overworked is not economical. Any properly set boiler, well covered in on top, and from which the heat in the flue chamber after it has left the boiler is not over 600°, may be said to be economical, whether it is a flue boiler or a tubular boiler. This heat standard is also modified somewhat by the pressure of steam carried in the boiler. The waste gases with a high pressure (say 100 pounds) are naturally of a higher temperature than from a low pressure (say 50 pounds), when run with the most economy as to fuel and use of steam. A flue boiler that is driven to excessive work may waste more heat than a tubular boiler having the same amount of effective heating surface. The large flues allow the heated air to flow in larger masses and at greater velocities, which is the principal point against flue boilers. 2. I have an engine 9 inches bore and 9 inches stroke, which I am running at 120 revolutions per minute, or the piston travels 180 feet per minute. Do I gain power by running the engine so fast? A. Your engine is running at an economical speed. You gain in power over lesser speeds. The figures you give are not sufficient for definite opinion.

(48) J. A. W.—Mange is a parasitic disease and is cured by insecticidal applications. Many formulæ have been tried. One runs thus:

Sublimed sulphur	16 parts.
Whale oil	16 "
Mercurial ointment	1 "
Oil of tar	1 "

The disease is recognized by loss of hair, local irritation, and desire to scratch. If not perfectly eradicated, it will reappear on cessation of treatment.

(49) E. De F. asks how to make and keep glue liquor always ready for use, that is glue water, so it will not, when cool, thicken. A. To keep glue liquid add a little acetic or nitric acids. For liquid glue the following formula is given:

Glue	8 ounces.
Water	½ pint.
Nitric acid (sp. gr. 1380)	2½ ounces.

We doubt if we can give you a wood filler combining the requirements stated.

(50) R. E. H. asks: 1. How can I keep a fine surface on a canoe in salt water? I have tried spar varnish, and it does not answer. A. We know of nothing better than boiled linseed oil, often rubbing clean with raw linseed oil on a coarse woolen cloth. 2. How can I make glue clear? A. You cannot make common glue clear. Use only white glue or isinglass.

(51) D. R. J.—The specimen sent is pyrites in calcite. It may contain a little copper, but not enough to make it of any value.

Enquiries to be Answered.

The following enquiries have been sent in by some of our subscribers, and doubtless others of our readers will take pleasure in answering them. The *number* of the enquiry should head the reply.

(52) Please give through your paper a process for giving wire a smooth polish, either by pickling or galvanizing, and oblige,—W. D. R.

(53) Kindly furnish me with a good formula for a good brick enamel for various colors, and the *modus operandi* for obtaining a good and lasting enamel upon the bricks.—O. K.

(54) 1. I want to make small springs for my violin holder, about ¼ of an inch wide and 2 in. long. What kind of steel shall I use, and how can I make them? 2. I desire to print my name in gold upon velvet. How can I make it?—R. T. F.

(55) Our city water mains carry a pressure of 60 lb. Suppose we attach a hose to one hydrant with a 1¼ inch nozzle and to another hydrant we attach a hose with a 1 in. nozzle, which of the two will throw the highest stream of water with the same pressure?—W. H. G.

(56) Will you please inform me the number of horse power a pipe five feet in diameter and thirty miles in length would convey of compressed air, the pressure being 100 lb. and 200 lb. per square inch?—J. S.

(57) 1. How many horse power will it require to drive a dynamo large enough to produce electricity enough to heat a round plate of iron 6 in. in diameter and 2 in. thick, to a low red heat, say 1,000° F. in 30 minutes time? How much power will it require to heat said plate to 2,000° F. in same length of time? 2. How much more power will it take per hour to heat a plate 8 in. in diameter by 4 in. thick and hold it at 2,000° for 24 hours, the temperature in room being held at 75°?—G. S.

(58) What is the test for China clay, and how does it sell?—W. H. C.

(59) I am a engineer and am running 35 horse power boiler and engine, but I am only utilizing 15 horse power. Now, for economy, I would like to know how far should the grate bars be from the boiler to give the best results in burning coal. We are going to change our firebox from wood burning to coal burning. Our boiler is a horizontal flue boiler, 12 ft. long 4 ft. diameter. Please state in your next issue, if possible. A constant reader.—F. H. G.

(60) Can you write me how to figure or give the rule how to figure the horse power of engines? Also how to figure out the safety valve of a steam boiler. —H. B.

Replies to Enquiries.

The following replies relate to enquiries published in last week's SCIENTIFIC AMERICAN, and to the numbers therein given:

(15) Speed of Fly.—The house fly gives 330 beats per second with its wings. Its absolute speed I do not know.—T. S.

(15) The flight of a house fly is impulsive and curvilinear. They are seldom seen to move in a straight or nearly straight line. Their momentary speed of flight is estimated at from 10 to 15 feet per second, under the impulse of getting out of harm's way.

(15) How fast can a house fly fly? Prof. C. V. Riley, of the U. S. Department of Agriculture, Division of Entomology, says he is not familiar with any published statement as to the rate of speed of the house fly, and has not made any observations upon the subject. He doubts whether this insect is capable of a long continued flight, and his impression is, from observing its short darts about a room, that it probably does not fly faster than 20 feet per second or thereabout, which would be at the rate of something over 13½ miles an hour. This, however, is a mere guess on his part, and should not be taken as at all authoritative.

(16) Grafting Wax.—(*a*) Take:

Pitch	4 ounces.
Resin	4 "
Lard	2 "
Beeswax	2 "

Melt over a slow fire, or (*b*) melt together equal quantities resin and beeswax and add enough tallow to produce the proper consistency.—A. V.

(16) Grafting Wax.—

Pine resin	50 parts.
Tallow	10 "
Turpentine	5 "
Spirits of wine	5 "

The resin is melted in an iron vessel. The turpentine is added, next the tallow, and finally the spirits of wine. Stir the ingredients thoroughly and cool.

(17) Speed of Birds. — The vulture is credited with a speed of 150 miles per hour; the wild goose and swallow, 90 miles per hour; the crow, 25 miles per hour. Carrier pigeons are credited with 600 miles in 8 hours, and 3 miles in 3 minutes and 24 seconds. Recent trials give about 1,100 yards per minute for carrier pigeons.—V. S.

(17) The vulture is supposed to be the swiftest bird, 150 miles per hour. The wild goose and swallow 90 miles. Carrier pigeon from Pesth, Hungary, to Cologne, Germany, 600 miles in 8 hours—75 miles per hour. Trials in New Jersey average about 60 miles per hour. No record of the hawk. See interesting articles in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 298,-271, 310, flight of birds and migration.

(18) Violin Varnish.—The famous Italian violin makers used, it is said, the following sort of varnish on their instruments: Rectified alcohol, half a gallon; six ounces of gum sandarac, three ounces of gum mastic, and half a pint of turpentine varnish. The above ingredients are put into a tin can by the stove and frequently shaken until the whole is well dissolved. It is finally strained and kept for use. If upon application it is seen to be too thick, thin with an addition of more turpentine varnish. The wood should be stained

before applying the varnish. For a red stain use camwood, logwood, or aniline. You can find the tone of a piece of wood by comparing its note when it is struck with the notes of any musical instrument tuned to standard pitch.

(18) C. C. M.—Red Varnish for Violins. —Dissolve over a moderate fire—

Sandarac	12 parts.
Shellac	6 "
Mastic	6 "
Elemi	3 "

In 150 parts 95 per cent alcohol which has been colored red with cochineal, or if a darker red is required, add dragon's blood gum. When the above is dissolved add 6 parts Venice turpentine. As this varnish is highly inflammable, use caution as to fire. Find the tone of a piece of wood by direct comparison with similar notes on the piano or any standard instrument. A violin in tone at the proper pitch by a tuning fork is very convenient.

(18) Varnish for Violins—Tone of Wood for Same.—Dissolve by heat 2 ounces amber in oil of turpentine 5 ounces, and drying linseed oil, 5 ounces. Color with dragon's blood or extract alkanet root. The tone given by a piece of wood depends upon its size, thickness, etc. Therefore, a test must be comparative. Cut square plates of equal size and thickness of a known wood and of the wood to be tried. Place the center of the plate upon the end of a cork or spool placed upon a table near the edge. Press the center of the plate of wood with the thumb and bow it near one of the corners. This will give the lowest note such a plate can produce, or the normal tone. The higher the tone, the better the wood.—T. S.

(19) Self-Propeller.—This approaches the perpetual motion problem, which has not been solved as yet. We know of nothing unless animated nature is a mechanical device.

(19) Mechanical Device.—Not in a mechanical sense. If built of good material, it would probably be perpetual motion, which is an impossibility. A machine could easily be made so fragile as to go to pieces when set in motion.—Y.

(20) Relief Maps.—Make the original in intaglio in plaster of Paris. Then beat papier mache into its cavities with a brush, as making paper cliches for electrotyping. See query No. 5 in SCIENTIFIC AMERICAN, December 15, 1888.—W.

(20) Relief maps are made in clay or wax and a plater cast taken from which a relief cast may be taken in plaster or papier mache. To make the papier mache cast requires that the mould of plaster should be backed by a stone slab, to allow of pressure by beating the papier mache into the mould with a stiff brush, and applying pressure with a cushion of sponge. Oil the moulds wih linseed oil to prevent sticking.

(21) Utilization of Leather Scraps: Paper Ware.—These are trade secrets; have tried to find them out, and have failed.

(21) Sundry Recipes.—I [illegible] Receipt Book," which largely treats of artificial leathers, papier mache, and water proofing. The chapter on imitations and substitutes covers a large range. See pp. 174 to 184. Paper gas pipe, bottles, etc., p. 454, 455. Papier mache for buckets, spittoons, etc., pp. 62 and 63. All of which appertains to this query.—G. D. H.

(22) Grafting Pear Trees.—Spring if done outdoors; on small stocks, it may be done indoors in winter, the stocks being kept in a cellar. There are good articles on the subject in Appleton's Cyclopedia. Also see SCIENTIFIC AMERICAN SUPPLEMENT, No. 122.

(22) Grafting.—For an article on the art of grafting see SCIENTIFIC AMERICAN SUPPLEMENT, No. 122. For a good grafting wax see Note and Query No. 16 (present list). The best time depends upon the season; after the sap starts and before budding time.

(23) Boiling Limed Eggs: Making Cider Vinegar.—(a) Try boiling slowly, beginning with cold water and bringing it to a boil. The eggs will then be cooked. If this does not answer, make a pin hole in the large end. (b) Add to your barrel, a quantity of the mother or lees of vinegar. Leave bung hole open; you may stick the neck of a bottle into it.—S. S.

(23) Limed Eggs.—We know of no way to prevent limed eggs from cracking when boiled. It is the confined gas expanded by heat that cracks them. Add a little yeast, ½ a pint to a barrel, to start your vinegar.

(24) Varnish for Maps.—Use Canada balsam or dammar varnish. The principal trouble will be in removing the old wax. The paper must be perfectly dry.—A. A. W.

(24) Mounted maps are sized with thin white glue and varnished with mastic.

(25) To Bleach Ivory: Cleaning Marble.—Bleach ivory by exposure to the sun under glass, or soak in a solution of binoxide of hydrogen. To clean marble, mix a quantity of the strongest soap lye with quicklime to the consistency of cream and lay on the stone for a day, clean it off afterward and rub with putty powder or whiting.

(25) To bleach ivory, place the ivory in a saturated solution of alum for an hour. Polish with a woolen cloth and wrap in linen to dry. Also with peroxide of hydrogen, to 1 pint add 1 ounce aqua ammonia. Warm, soak the ivory for 24 hours, wipe and polish with chalk.

(26) Refining Cotton Seed Oil.—Ten tons of crude oil are treated with 30 cwt. caustic soda lye of 10° to 12° Twaddell at 60° Fah. After agitation, if oil is not yet colorless more lye is added, and eventually all is left to stand 12 or 15 hours. The clear oil is then run off, washed, and bleached with chloride of lime or exposure to sun. It may be used directly to fry in, as lard.

(26) Refining of Cotton Seed Oil.—To 100 gallons crude oil add gradually 3 gallons caustic potash lye (45° Baume), with constant stirring for several hours; or, the same quantity of oil, add 6 gallons soda lye of 25° to 30° Baume, heat to 200° to 240° Fah., with constant stirring. Allow it to settle and cool. Decant the clear oil and filter the residue with canvas bags and pressure. When properly and cleanly done, the refined oil has the color, transparency, and taste of olive oil, and is largely used for culinary purposes, and used as an adulterant of olive oil.

(27) Bell Telephone, Battery, etc.—1. No. 2. Use No. 36 copper wire, silk covered. Wind to 80 ohms resistance. This will require about 35 feet of wire. 3. A properly made single contact transmitter will give every satisfaction. The multiple-contact instruments are sometimes considered more sensitive. 4. For details on telephone apparatus, consult "Bell's Electric Speaking Telephone," by Prescott. 5. Lead is unsuitable, as it will not hold the carbons firmly. Dip the dry carbon tops in melted paraffine, copperplate them, and cast the plate in type metal. This will give a first class job. You may cast the cover directly around the carbons if you wish. It will not crack them. 6. The cast iron-zinc couple excited by caustic soda is probably best for your purposes.

(28) Erasing Ink.—Oxalic acid mixed with citric acid may be used. There are two distinct species of red ink, aniline and carmine, on the market, and some will be found hard to remove.

(28) For Ink Eraser.—Equal parts of cream of tartar and citric acid in solution with water. Or, a more powerful one, a saturated solution of oxalic acid in water. The red inks are made of various bases for the color, as Brazil wood, cochineal, and aniline red. The aniline red may be removed by alcohol acidulated with nitric acid. No receipt for the other reds.—G. D. H.

(29) Driving ⅛ H. P. C. and C. Motor.—Your water power (⅝ tap, 25 feet head) is ample. Donaldson's "Water Wheels" gives details of such matters. For battery, you would need large bichromate cells, say one gallon each. Eight or ten such cells should suffice.—C. H. P.

(30) Tempering Steel.—SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 71, 36, 37, 95, 103, 105, and many others treat of this subject of tempering steel.—Sup.

(30) Tempering Tools.—To temper cutlery, daggers, bowie knives, butcher knives, etc. Edged cutlery should be hardened before the blades are finished or sharpened to prevent cracking. Should be heated to the lowest temperature at which the particular kind of steel that it is made of will harden. If of German or spring steel, a full cherry red; if of tool steel, a lesser brightness in the heat. A slow fire that is long enough to heat the whole length of the blade equally is necessary. When at the proper heat, plunge the blade exactly vertical in water at shop temperature. Add a little salt, a handful to a pail. Then smear the surface thickly with whale oil or linseed oil and heat carefully over the open fire, so as not to overheat the point, until the oil flashes flame all along the blade. Then plunge vertically in oil or warm water. See also a valuable paper by Joshua Rose on The Hardening and Tempering of Steel, in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 95, 103, 105.

(31) Rubber Oxygen Bag.—It is best to buy one. Make of rubber cloth (cotton drill coated with rubber), double seaming at joints, and paying same with India rubber cement. A copper or brass reflector can be silvered by regular electroplating process. First amalgamate the surface to be plated. Directions for plating can be found in many books and back numbers of SCIENTIFIC AMERICAN SUPPLEMENTS.

(31) H. P.—Bags for Gas.—Rubber bags suitable for oxygen gas are beyond the ways and means of an amateur. We recommend you to obtain one through the rubber trade. The silvering of a metal reflector should be an electro deposit, which you will find described and illustrated in SCIENTIFIC AMERICAN SUPPLEMENT, No. 310. The polishing of the silver surface you may do by rubbing the surface with a buckskin pad stuffed with cotton and wet with a paste of rouge and water.

S. H. sends a beetle specimen, and says: The inclosed beetle was found in a pine seat of a painted chair. It was embedded in a cavity about 1¼ inches deep. The writer having been in the furniture business a number of years, and this being the first instance under his notice of an insect attacking painted furniture, would be under obligations should you enlighten him concerning the name, habits, and other information relating to the subject.—A. Prof. C. V. Riley, of the U. S. Department of Agriculture, Division of Entomology, says the specimen is a common longicorn beetle known as *Monohammus scutellatus*, which is a common borer of pine trees. It is found all through the Northern United States, infesting, of course, only standing trees. It remains for a long time in its preparatory stages, and is also under unnatural conditions capable of considerable retardation of development. Either in the larva or pupa state it was living in the tree when it was cut, and its particular burrow was undisturbed by the sawing and the subsequent manufacture of the chair, from the seat of which it afterward emerged. Instances of this kind are not uncommon, and all are to be explained in this way. It does not, of course, as S. H. imagines, "attack painted furniture."

☞ Books or other publications referred to above can, in most cases, be promptly obtained through the SCIENTIFIC AMERICAN office, Munn & Co., 361 Broadway, New York.

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