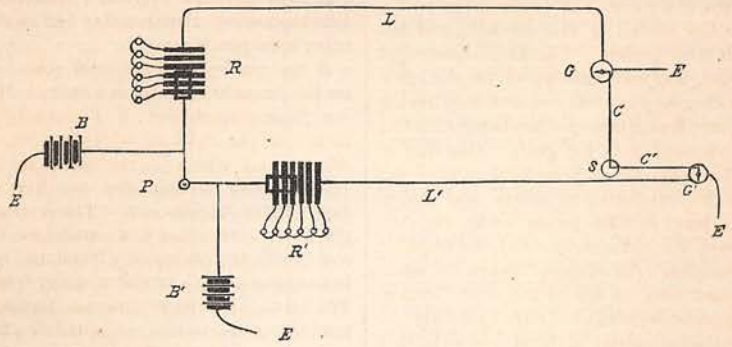
plished in various studies and professions. In fine weather, the classes will meet in the orchard or the grove, near Mr. Alcott's house, which is pictured in SCRIBNER for February, and which stands on the Lexington Road, next to Hawthorne's "Wayside." Possibly this experiment, which Mr. Alcott has long intended to try, may result in a permanent school during a portion of the year for the prosecution of those studies that have so long given Concord a name in the world.

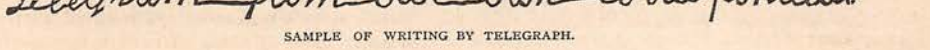
THE WORLD'S WORK.



The Writing Telegraph.

COPYING and autographic telegraphs have already been made the subject of experiment, but in all the apparatus already tried the mechanism is too complicated to be of much practical value in ordinary telegraphy. A more recent invention, called the writing telegraph, reproduces at the distant end of a telegraph line marks, letters and words by means at once simple and ingenious. The mechanical principle upon which the new writing telegraph is founded is the familiar law of resultant motion when two opposing forces are combined. The electrical part of the invention consists of suitable apparatus for transferring over wires these two forces and recomposing them into a resultant motion that shall exactly resemble the original motion. To make this clear it must be observed that the action of a pen or pencil in writing is twofold. There is the up-and-down stroke and the lateral movement of the pen along the paper, the curved letters being the resultant of these two opposing motions. In the writing telegraph we have an upright pen fixed in one position, but with the point free to move in two directions, up and down and from side to side.

The above figure is an ideal sketch of the apparatus. The writing pen, P, is held in the hand and is used in forming the letters on a strip of paper that moves under it. To P is fastened at right angles two arms or rods, bearing at the ends metallic plates. At R and R' are sets of metal plates standing on edge and isolated from each other by layers of paper soaked in paraffine, each plate being connected by wire with a resistance coil. The flat plates at the ends of the rods rest on the edges of these upright plates and are free to slide to and fro covering a greater or less number of them as they move. At B and B' are batteries with lines to earth and at L and L' are the line wires. It will be seen that as the pen is moved in writing, the rods pull the plates to and fro, and as these plates slide they short-circuit the current in the resistance apparatus, cutting out a greater or less number of the coils and thus continually altering the electrical resistance in the line wires. The up-and-down strokes of the pen alter the resistance in the line, L, and the lateral strokes change the resistance in the line, L', and as the movement of the pen in forming a curve is the resultant of two motions, each motion is given to the line in its exact proportion; in other words, the resultant mechanical motion is expressed in electrical resistances of more or less value. At the receiving end of the double line are two galvanometers, G and G', the line, L, being connected to G, and the line, L', to G', and from each to earth. The needle of each galvanometer is balanced, and from the point of each needle is taken a delicate cord, marked c and c'. At S is a self-inking style, or pen, suspended by a thread and free to move in any direction. The cords, c and c' are fastened to the style, S, and opposite to each are delicate springs not shown in the figure. These springs exactly balance the strain on the cords from the needles as long as the resistance in the lines is constant and the needles remain at rest. The operation of the apparatus may now be easily understood. The movement of the pen changes the electrical resistance in each of the lines, the up-and-down stroke affecting one line, the lateral strokes the other. The needles of the galvanometers swing to and fro under these changes in



SAMPLE OF WRITING BY TELEGRAPH.

electrical resistance and pull the style in opposite directions. If, now, the pen describes a curve that is the resultant of two motions, the resistance in each line is changed in corresponding degree, precisely as if the curved motion had been split into its two right-angled motions and translated into electrical resistances of equal or unequal value. The needles pull the style in two directions at the same time, and as it cannot follow both motions, it takes a path between them that is the result of the two forces and reproduces the original curve made by the pen. The strip of paper under the style moves by clock-work, ink flows from the style and traces the curves and marks made by the pen; in fact, reproduces the message written by the pen at the other end of the line. The details of this remarkable invention have been worked out in a simple and tolerably successful manner.

We present a sample of the writing as received on two wires at a distance of forty miles. The writing is sufficiently clear for all practical purposes, and though the apparatus works rather slowly, it may yet reach a valuable practical position in telegraphy. At its present stage it has demonstrated that hand-writing can be transmitted with precision over long distances, and the further development of the invention may be awaited with considerable interest. The invention is English in origin and was first used between London and Brighton.

Tubular Piles.

IN sinking tubular piles in deep water and in putting down driven wells it has been the custom to drive the pile or pipe by striking on the top of the tubes. This answers very well for short tubes, but in sinking deep wells and long piles it has been found better to deliver the blows of the weight or hammer at the bottom of the pile. A long cylindrical weight designed to strike on the flat head of the steel point, or toe, of the pile is suspended inside the tube and let fall on the point, the tube itself acting as a guide for the weight. It is claimed that by this method long piles are driven with facility and precision, all danger of bending the pipe or driving it out of perpendicular being avoided. This method of driving tubes in the ground has suggested a very useful form of iron base for lamp, signal, tent and telegraph poles. An iron tube with steel point and heavy flange at the top is driven into the ground by means of the cylindrical weight till the flange is level with the surface. The telegraph, lamp, or other post of iron, has a similar flange designed to fit the flange on the tube, and the two may be screwed together. For wooden posts a cast-iron socket may be provided and screwed to the flanged tube. Such an iron tube driven in the ground would be useful for a variety of purposes when a firm and permanent base is wanted.

New Preservative Agent.

DURING some experiments in separating sugar from molasses a double salt of borate of potassium and sodium was found that proved to have valuable antiseptic properties. This salt is now manufactured on a commercial scale, and costs about ten cents a kilogram. It is obtained by dissolving in water equal quantities of chloride of potassium, nitrate of sodium and boric acid, filtering and evaporating to dryness. The salt is said to be quite deliquescent and must be kept in tight bottles. It is quick in action, retains its qualities for a long time and has no injurious effect on the taste, smell, or healthfulness of the substances to which it is applied. It has already found a use in making sausages, in preserving meats, in tanning and in butter-making. A small quantity of the salt added to milk will preserve it in good condition for a week. It is also used in preserving beers and wines and is being made the subject of experiment in several other directions.

Memoranda.

CARBON desulphide has been tried with success in extinguishing fires in chimneys and other confined places. A few kilograms burned on the hearth of a chimney that is on fire has been found sufficient to extinguish the fire without injury to the house or furniture. The combustion of the carbon desulphide produces great volumes of carbonic and sulphurous acid gases which rise in the chimney and smother the fire. From experiment it has been found that out of 319 burning chimneys, 251 were extinguished in this manner without other assistance and without even disarranging the furniture of the rooms where the fires occurred.

A new form of thermo-regulator employs the varying tension of a saturated vapor under the influence of changing temperature as a means of controlling the flow of gas in a gas-stove and thus maintaining a fixed temperature. A small vessel containing methylic ether and connected with a mercury manometer is attached to a gas-stove intended to be kept at a fixed temperature, the movements of the manometer controlling the flow of gas. So sensitive is the apparatus that a stove has been maintained within one-tenth of a degree of a given temperature, this precision being obtained by the small mass of the vapor and the rapidity with which its tension changes under slight variations of the temperature.

The patent law restrictions laid on the use of the common process of nickel-plating have led to experiments in other directions to secure the same end, and a new process is announced by Professor Stratbo that is said to be both simple and effective. To a solution of from five to ten per cent. of chloride of zinc, sufficient nickel sulphide is added to give it a decided green color, when the solution may be raised to a boiling point in a porcelain vessel. The articles to be plated, thoroughly cleaned from oxide and grease, are suspended in the boiling solution for from thirty to sixty minutes, or till well covered. They may then be taken out, washed in water in which a little chalk is suspended, dried and polished. By employing a cobalt salt in place of the nickel, a plating of cobalt may be obtained. This process is not patented.

THE WORLD'S WORK.

Novel Method of Testing Iron Wire.

AN apparatus, founded on well-known laws of electro-magnetism, has been recently brought out that promises to be of great value in testing iron and steel wire. Upon a firm foundation is placed a helix of insulated copper wire wound upon a spool of paper, rubber, wood, or other non-conducting material, and through the center of the spool is bored a hole, so that a wire rod may be passed through the helix. When the helix is connected with a battery, any piece of iron passed through it becomes an electro-magnet. Opposite one end of the helix is placed a magnetometer, having a needle delicately balanced and placed upright. The magnetometer is placed upon a sliding support so that it may be placed in any position in relation to the electro-magnet, and by moving it forward or backward before the helix, a point may be found where the needle will indicate the maximum intensity of the magnetism in the wire rod. The magnetometer is then fixed in this position by binding screws. The rod of soft iron in the helix being of known density and tensile strength, it becomes, by the aid of the magnetometer, a standard of comparison in testing other wire. The needle of the magnetometer has an aluminum pointer riveted to the upper end, and as the needle moves the pointer traverses a semi-circular scale divided into 180 degrees, marked from zero in the center to 90 degrees each way. After arranging the apparatus with the test piece of soft iron so that the pointer rests at zero, the rod is removed and a steel rod of the same size and length and of known density and strength is placed in the helix. At once there is a change in the position of the needle, indicating a change in the magnetism of the wire. When the needle is at rest, its position on the scale is carefully noted. This gives the relative magnetism of two rods of the same size and length and varying density and strength, and from this data, it is easy to measure the comparative density and strength of other wire of the same size. Reels are set up on either side of the apparatus, and upon one is wound a quantity of steel wire to be tested. Having passed the wire through the guides, under the needle and through the helix, it is fastened to the other reel. On turning the reel the wire passes through the apparatus, becoming magnetized as it passes the helix, and recording its magnetic condition by the position of the needle, and thus its density and strength. If, while the wire is passing, the needle falls to zero or below, it shows that the portion of the wire then in the apparatus is of the same or less density than the soft iron test rod, and as the needle approaches the point marked by the steel test rod, so the density approaches that of the steel test rod, and thus its comparative strength may be seen at once. If there is a flaw, crack or break in the wire, though it is not visible on the surface, the needle instantly shows it, as every change, however small, in the density of the wire is indicated by a change in its magnetism. This most interesting apparatus can be arranged for testing plates, shafting, columns, parts of guns and machinery of every shape and size, and seems likely to prove of great value in finding flaws and minute imperfections in iron that cannot be found by sight or touch.

New Salt-water Condenser.

THE demand for fresh water for the use of the passengers, and for supplying the boilers on board steam-ships, has led to the use of extra fires and boilers for making steam that may be turned into water in a suitable condenser. A new form of steam-boiler for obtaining fresh water utilizes the waste heat of the smoke-stack and saves the expenses and labor of the extra fire and boiler. An oval-shaped vessel of iron 7.6 centimeters (3 in.) in diameter, as long as the interior diameter of the smoke-stack, and of any convenient width, is hung on edge in the stack at the level of the deck, or just above the furnaces. This forms a boiler using the waste heat of the fires without materially injuring the draft. One end of the boiler is connected with a tank containing sea water placed on the deck and at the other end is a steam-pipe for taking the steam to some form of condenser. In the boiler is a scraper, hung upon a rod that passes through both ends of the boiler, and by drawing the scraper backward and forward the salt that accumulates in the boiler may be scraped off and removed through a hand-hole at the bottom. All parts of the apparatus appear to be worked out with care, and it is said to give a good supply of fresh water with very little attention and at no extra expense. The economy of the boiler has already led to its adoption on several lines of steamers.

Improved Refrigerating Apparatus.

THE export of fresh meat from this country and from Australia and South America to Europe has led to the invention of a number of processes for keeping the meat cool during the voyage. The most simple, and, so far, the most successful, process consists in making an air-tight chamber in the steamer, and pumping air by means of a fan and special engine, through a series of pipes packed in ice. The air is cooled to about 35° Fahr., and is deprived of its moisture by condensation in passing the pipes, and the meat is preserved perfectly so long as the supply of ice holds out and the fan is kept in motion. An improved process recently announced dispenses with the use of ice and accomplishes equally good results, with only a moderate expenditure of power. The new method is founded on the simple fact of the heating and cooling of air when compressed and allowed to expand. A meat chamber of any convenient shape and size is fitted

up, and near it is placed an air compressor driven by steam-power. The first result obtained is a heating of the compressed air, and to get rid of this heat, a spray of cold water is let into the chamber containing the compressed air at each stroke of the compressor. This lowers the temperature to that of cold water, and by an ingenious system of fine grating, the moisture that saturates the compressed air is extracted. The air is passed through a series of finely perforated disks, on which a large proportion of the water is caught and allowed to pass away through suitable valves. Within the meat chamber are arranged a series of pipes hung up in zigzag form (probably straight pipes joined by return-bends), and the compressed air is allowed to pass through these, still farther chilling it and removing by condensation the remaining moisture. It then passes to the cylinder of an engine and is there allowed to expand in driving the engine. The exhaust air is then taken by pipes into the meat chamber, and there allowed to expand to atmospheric pressure. The engine is also coupled to the steam engine that drives the compressors, and thus the air in expanding performs part of the visible work of compressing. By this ingenious process the air is cooled three times and enters the chamber, not only dry, but very cold. There is less waste of power by this process, and a far lower degree of cold and a freedom from dependence on ice. By taking the air for compression from the chill-room a still lower temperature may be obtained, and by joining one apparatus to another, there is apparently no limit to the lowering of the temperature of the air. The practical limit is found in the freezing of the lubricants used in the engine that is driven by the compressed air. Oil is frozen solid and stops the engine, and in practice it is found that glycerine must be used, and here the process stops, for, if the chilling and rechilling is carried farther, the glycerine must freeze and the engine will be unable to move. The process has been kept in operation for three months without stopping and has proved to be entirely practical and satisfactory, and will undoubtedly soon be tried on steamers making long voyages.

The Horograph.

THE success of the electric pen has led to the introduction of two new forms of perforating or stenciling pens. One of these employs compressed air as a motive power in driving the needle. A small cylinder is placed at the top of the pencil or handle, and in this is a diaphragm that, under the impulse of puffs of air from a small compressor driven by foot or other power, moves rapidly up and down and thus actuating a needle affixed to the center. This form of stenciling device is already in use to a limited extent. The horograph is a pencil with a perforating needle driven by clock-work. The needle is fixed to a cam that is operated by a spring and suitable gearing, and moves at the rate of several thousand strokes a minute, so that the paper is perforated even when used for slow writing or drawing. A key is fixed to the handle of the instrument, and by pressing it with the thumb, the needle may be stopped or started at will. The key for winding up the spring is hinged to the side of the case that contains the works. A ring is attached to the top of the case to suspend the pencil by an elastic cord from the ceiling, to relieve the weight from the hand, but in ordinary work it is found the hand soon becomes accustomed to the weight, and it may be used without assistance. The copying is performed in the same manner as with the electric pen.

Improved Violin.

THE violin, though often the subject of experiment, has not been materially altered in form for more than two hundred years. A recent improvement introduces an additional sound-board, and makes a more radical change in its construction than anything tried since the days of the great Italian violin-makers. The new sound-board exactly follows the shape and curves of the breast, or top, of the violin, and is placed between the breast and back. It has a base bar, sound openings and sound-post, and is securely fastened to the sides of the instrument. The oval openings are a trifle larger than those in the top, and the sound-post is placed near the regular sound-post which passes directly through the new sound-board. The extra sound-board is made of well-seasoned pine, and divides the instrument into two parts or chambers, and practically making a double instrument of the violin without changing its external appearance or adding materially to its weight. The effect of this additional sound-board is to greatly increase the volume of the sound and, by developing obscure and partially lost over-tones, to enrich the quality of the tone. The improved violin has already attracted the favorable attention of musicians, and is soon to be manufactured upon a commercial scale.

A New Gum.

THE persistent search for new gums allied to gutta percha and rubber has been rewarded by a new gum which has been named "Belata." It is won from the "bully tree," a native of the Amazon region, and in appearance it is said to closely resemble gutta percha, though it is tougher and more flexible. It is tasteless and has an agreeable odor when warmed. It may be joined piece to piece at 120 Fahrenheit, and melts at 270 Fahrenheit; is soluble in cold benzine and carbon desulphide and in warm turpentine. It may be strongly electrified by friction and is a better insulator than gutta percha. It is thought that the gum will find many uses in the arts.

Removing Metallic Substances from Grain.

THE introduction of grain-binding machines employing iron wire to bind the sheaves very quickly led to the discovering that the bits of wire, cut off each time a sheaf was bound, caused a great deal of trouble in the after process of grinding. The ends of the wire mixed with the grain reached the

mill only to break and scratch the stones and machinery, and to produce friction and heating that sometimes resulted in setting fire to the mill. So serious became this matter that the millers objected to receiving any grain bound in machines using wire. Fortunately, the difficulty has been surmounted by the introduction of appliances for removing the bits of iron from the grain before passing it to the mill. Experiments showed that a common magnet hung in a grain-spout would catch and retain particles of metallic substances mixed with the grain. Several methods of accomplishing the same results are now in use in Western mills, and they may be divided into two classes: those using permanent magnets, and those using electro-magnets. It has been found that a dozen "machine" magnets (preferable to "horse-shoe" on account of their shape) hung in a grain-spout are sufficient to arrest every particle of magnetic metal, from pieces of wire several centimeters long, down to iron filings and metallic dust. The usual plan is to saw off a portion of the top of the spout and to divide it into three pieces and cut holes in each piece for the legs of the magnets, placing four magnets in a row across the spout. This gives three rows of magnets placed directly or diagonally across the stream of grain, the diagonal position being considered the best as the grain is driven from side to side in passing, and brought into close contact with the magnets. The magnets may be lifted out of the spout in groups of four by taking off one of the covers, and may then be cleaned and put back without disturbing the others. Another method of hanging the magnets is to cut three slots across the spout, and hang the magnets on a rod with blocks between them to keep them in position. By this arrangement, the magnets may be removed one at a time, or in groups of three or four, as most convenient. By taking out only a portion of the magnets at one time, enough of them remain to keep up the work while the others are being cleaned. The metal adhering to the magnets is easily brushed off, two clearings in a day being found sufficient. By employing bars of soft iron in connection with coils of wire and a battery, electro-magnets may be used, and in lifting out the magnets it will only be necessary to break the circuit, when the metal adhering to them will instantly drop off. Another form of apparatus employs horse-shoe magnets, having a paper or wooden filling between the legs, set upright on the ends of arms revolving horizontally in a circular tank, very much after the manner of some forms of mixing-machines. The grain is delivered at the edge of the tank, and is pushed by the revolving magnets toward the center, when it escapes through an opening in the bottom of the tank. Another device employs a series of permanent magnets and a traveling apron for conveying the grain away after it has passed over the magnets. The only advantage of the use of electro-magnets is in the facility of cleaning them by breaking the circuit and demagnetising the iron. By suitable clock-work this can be done automatically, provided there are appliances for shutting off the grain and for catching the metallic dust when the magnets are thrown out of action. The first and most simple of these grain-cleaning appliances was brought out by persons interested in mill property, and has been wisely given to the public without patent restrictions. The other appliances are patented.

New Method of making White Lead.

A NEW method of making white lead is announced that, while it is based on the chemistry of the present system, is entirely unlike it in mechanics. The lead, instead of being cast in thin plates or "buckles" and then submitted to the fumes of a weak acid while buried in a mass of fermenting manure as in the "Dutch process," is poured while melted into an iron sieve. It drops through the meshes of the sieve into water and assumes the form of slender threads. A mass of these threads are then placed in a tank and vinegar is poured over them and allowed to drain away. Enough of the acid clings to the lead to cover it with a film and as the air passes among the threads the lead is oxidized. The vinegar is then poured over the threads again. This time it carries away the acetate of lead formed on the surface of the threads, and at the same time leaves a film of vinegar behind. This alternate moistening of the lead with the same vinegar finally produces a concentrated solution of basic acetate of lead, and by passing a current of heated carbonic acid gas through the liquid the carbonate of lead is formed. The clear vinegar may then be drawn off and, added to a fresh supply, may be applied to the lead again in the same manner till the threads are consumed.

Proposed Treatment of Hop-vines for Fiber.

A NEW process is announced that promises to add greatly to the value of the hop crop. The stems of the vine are boiled in water containing soda or soap for about forty-five minutes and then thoroughly washed in clean water. They are then boiled in a very delicate solution of acetic acid. This causes the skin to part and the interior fiber may be washed out in water and dried. The resulting fiber is said to resemble flax and to be very soft and elastic. Should the process prove of practical value upon a large scale it will be of great benefit to our already large hop-growing interest.

in fact, a little play drawn out into a story, in which the gorgeous opera-cloak of the absent Colonel St. John plays pranks somewhat like those of the piece of paper in that much applauded modern theater-piece called "Pattes de Mouche." The cloak has a sort of life of its own, and the two families begin to be superstitious; the Douglases allude to it as O. C. St. John, Esq., and when Tom slyly takes it out of pawn, and leaves it on the steps of the St. Johns' hired house, Pomp says: "Massy gracious, Miss Leslie, what yer t'ink? Dat ar op'ra-cloak's done come ob hisself; paid his own pawn-ticket, an' done rung de bell! I see his brass knobs a-wigglin' when I opened de do'. De days ob mir'cles am returned." One feels that more might easily have been made of this cloak; it might have gone through many other adventures; but in that case there would have been too much loss of naturalness. As it is, we follow the ins and outs of the cloak, with a healthy contempt of probabilities and a grateful sense of being amused. In this connection may be noticed what the author makes Tom say in respect to the pictures of a friend of his—one Bob Simpson. "I wish I could show you his pictures. They are very funny,—many of them. He's making money fast. Funny pictures sell,—people like to be amused."

THE WORLD'S WORK.

Improved Method of Insulating Underground Wires.

Of the many methods that have been tried to make a cheap, durable, and well-insulated telegraph line or cable for placing under streets and under water, the latest and most promising employs a wrought-iron tube containing the wires and filled with a cheap oil. The wires are of copper (copper having seven times the advantage over iron as a conductor at only three times the cost), and covered with cotton woven on by machinery. Dry cotton makes a good insulating material, a very thin layer being sufficient to keep the wires apart and well insulated. The wires laid in a bundle in a pipe underground would be insulated for all practical purposes as long as kept in dry air. Moisture is taken up by the cotton, and this destroys the insulation, and to exclude moist air and water the pipe in which the bundle of wires is placed is filled with kerosene. In a new line or cable laid across the Delaware, twenty wires are laid in a pipe 3.8 cm. (1½ in.) in diameter and laid across the bed of the stream. The ends of the pipe are brought to the shore and bent upright to form two stand pipes, one at each end. The wires nearly fill the pipe, and oil is poured in till it rises to the top of the two stand pipes, thus securing sufficient pressure to keep the pipe full to the exclusion of air and moisture. The experiments made with this form of underground cable lead to the hope that it will take the place of the unsightly and dangerous telegraph poles and wires in our streets and thus lead to the suppression of the only objection to the continuous spread of telegraph and telephone wires in our cities.

Progress in Metallurgical Science.

The progress of commerce and manufactures is now almost wholly governed by the progress of science. Important steps in scientific discovery lead to immediate and equally important changes in the practical methods of manufactures and the routes and facilities of trade. The telephone has created a new branch of telegraphic business, and the Bessemer converter overturned the manufacture of iron and steel and created new uses and new markets for steel. Within a short time has appeared another important scientific discovery that, by the use of a new material in an old process, makes a change in the manufacture of steel and modifies the commercial position of whole districts and trades. The Bessemer converter, though a comparatively recent invention, has already made a very great change in the relative positions of iron and steel, increased and cheapened the manufacture of steel, and thus created new markets for it. The last step has been to apply to the interior of the converter, or vessel in which the steel is "blown" in the process of extracting the phosphorus and sulphur, a lining prepared from lime in place of the linings hitherto employed. This new lining is found to produce a more complete elimination of the phosphorus and sulphur, and making it possible to use ores of an inferior quality and ores hitherto thought to be valueless for steel-making. A modification of this application of lime in the Bessemer is also used in the Siemans-Martin steel-making process and with the same results, a widening of the range of ores suitable for steel-making. The chief interest in this discovery lies in the fact that ores thought to be valueless for steel are now made available. The districts producing these inferior ores will find a new market for their material; the quantity of steel made by these processes will be largely increased and the price undoubtedly lowered, both of which will tend to increase its usefulness and sale. This invention is English in its origin and is to be tried at once in France, Germany and this country. All metallurgical interests will be undoubtedly greatly changed, iron becoming of less use and steel more and more taking its place, from this comparatively slight change in steel-making processes.

Improved Locomotive Fittings.

The necessity of suppressing the noise of the engines used on elevated roads has led to two valuable improvements that should be applied to all engines passing through city streets. The exhaust steam, instead of being thrown into the smoke-stack,

thus producing a loud puff at every stroke, is taken directly from the cylinders into large tanks or cylinders of iron standing upright on each side of the stack. Each of these tanks has about ten times the capacity of the cylinder below it, and within it the steam expands freely. It then escapes through a pipe directly into the stack, escaping upward through an annular nozzle. It here acts as an injector, giving the smoke-stack a powerful and steady blast, in place of the usual intermittent blast. The fire, as a result, is urged evenly and at a nearly uniform rate without puffs and starts as in the ordinary engine. From personal observation of this useful invention, it is found that the noise of the blast is virtually suppressed, being only faintly heard in the cab and quite lost in the street below. The engine steams equally well, the steam-gauge remaining at an almost uniform position during a run. The fire being driven steadily, it is thought the boiler will be saved much of the wear that attends the intermittent action of the blast, and at an economy of steam, fuel and material. The second device is designed to suppress the noise of the blast from the vacuum brakes. This is accomplished by turning the jet of mingled steam and air into a small iron vessel filled with glass beads. These beads are kept in place by wire netting, and the steam and air passing through the minute spaces between the beads escapes at the top in a diffused cloud without noise. The noise caused by the escape of steam from the safety-valve is reduced by taking the steam through a pipe back to the water tank in the tender, or by turning it into the expanding tanks over the cylinders.

Gas and Steam Motor.

THE gas engine, at first a noisy, unreliable motor of only one or two horse-power, has within the past few years been greatly improved, and in its latest forms becomes a reliable and useful machine having a power equal to eight horses, and is gradually finding a place in small manufactories wherever a cheap and easily managed motor is required. The most important step in this improvement was in the suppression of the noise, and in the new silent gas engines this great objection to these motors is removed. The latest form of gas engine goes one step further and becomes a combined gas and steam engine, the consumption of the gas producing the heat needed to make the steam and without the aid of a separate fire. There is no boiler, in the ordinary sense, the boiler being contained in the engine and the steam being used in the cylinder in which the gas is burned, the combustion of the gas at the same time producing more steam. Like other gas engines, this motor employs one single-action cylinder and depends on the momentum of a fly-wheel to continue the stroke and restore the cylinder to its acting position. The motor consists of two upright cylinders placed side by side in an iron frame that carries at the bottom and beneath the cylinders the shaft to which the connecting rods of both cylinders are directly connected. The smaller of these cylinders is the compressor for mixing and compressing the air and street gas that are to be burned in the longer or motor cylinder. On turning the balance-wheel the piston of the cylinder is drawn down, forming a vacuum into which the air and gas are admitted in the right proportions. The return of the piston compresses the mingled air and gas, and as they are prevented from escape by the way they entered, they pass through other connections into the large motor cylinder. There they meet a lighted gas-jet and take fire, and in burning force the piston downward and thus impart motion to the machine. On the up-stroke of the piston in this cylinder, the burned-out gas, still retaining nearly all its heat, passes upward into a reservoir or boiler placed on top of the cylinder. Each of the two cylinders has a water-jacket that communicates with the water in this boiler and by extracting heat from each assists to raise steam in the boiler and at the same time keep the cylinders cool. Suitable slides governed by eccentrics on the shaft control the movements of the gas from one cylinder to the other and thus make the motion continuous. A governor is also supplied to regulate the supply of gas to the engine. After one or two turns the engine becomes self-acting and runs continuously as long as the gas supply is maintained. In a short time after the engine has started, the heat of the burning gas, escaping through the exhaust into the boiler, raises steam, and this steam is taken to the motor cylinder and admitted at the same instant that the compressed air and gas enter and are flamed. The steam assists in driving the engine without in any way interfering with the burning gas, and after being used passes on with the productions of combustion to the boiler to assist in raising more steam. In its other parts, the device of maintaining a lighted jet of gas, etc., the motor resembles the former styles of gas engines. Its chief interest lies in the combination of a gas and steam engine in one, without the aid of an extra fire. The steam is said to act as an excellent lubricant in the cylinder and to prevent the soiling of the parts occasioned by the burning gas. Motors of this style have been made up to eight horse-power and are reported to be easily started and to be efficient in action.

New Steam Condenser.

A NEW form of condenser, for condensing the exhaust-steam of engines without the aid of an air-pump, has been brought out. It consists, essentially, of tanks for holding the cold water, a condensing chamber and a pipe placed vertically under it, designed to carry off the water of condensation, and at the same time to produce a vacuum in the condenser. The condenser is a circular vessel of iron, resembling two broad-lipped bowls, bolted together at the edges. The steam enters the chamber at the top, and the pipe for the cold water enters just below it, the steam and water meeting within the condenser. A small tank for cold water is placed just above the condenser and another and larger tank is placed beside or below it, as may be convenient, and pipes are arranged to give access to

the condenser from either tank at will. On board ship, or beside streams, the sea or river water takes the place of the larger of these tanks. The escape-pipe for the water of condensation is fitted to the bottom of the condenser, and is made as long as convenient, in order to get a fall for the water and to create a vacuum in the condenser. The operation of the apparatus is simple, and when once started it works automatically so long as the steam flows. The inlet for the cold water from the upper tank is opened and the water flows downward into the condenser, spreading over a disk inside in the form of an annular sheet, and filling the condenser about one-third full when it overflows a funnel-shaped opening below and escapes into the waste-pipe in a vortex, dragging the air after it, thus making a vacuum in proportion to the height of the fall. The steam enters the top at the same time, and meeting the cold sides of the condenser and the film of falling water is condensed and escapes as water below, assisting to maintain the vacuum. As soon as the operation is started, the upper tank of water is shut off and connection is made with the lower tank (or the sea) when the apparatus acts as a syphon, lifting its own water as fast as needed. The apparatus is reported to work well and with economy. Its use is, however, limited to places where the fall of water is sufficient to secure a good vacuum, the best results being obtained where the discharge pipe is 9.75 m. (32 ft.) long. The fact that the air-pump is dispensed with and thus the power of the engine is saved would seem to make the apparatus useful in many situations where economy of space and power must be considered.

Some Electrical Novelties.

By a new arrangement of the parts, a common form of electro-magnet has been made into an electro-dynamometer, or apparatus for measuring the strength of electrical currents. A hollow coil or spool of wire is placed upright on a base. Just above it is hung upon a spring a core of iron, the weight of the core stretching the spring to the zero-mark on a graduated scale. This makes a spring balance or weighing apparatus, precisely as if designed to measure weights placed on the suspended core. On passing a current through the coil, the core is drawn downward into the coil, stretching the spring balance and showing the strength of the currents upon the scale. By a simple arrangement the apparatus may be made self-recording and reporting by the varying pull or attraction on the core, the varying strength of the electrical current.

A new form of receiving telephone, entitled the rotophone, and employing mechanical force, as in the motograph, though on an entirely different plan, has been brought to practical use on telephonic lines. A bar electro-magnet is passed through a coil connected with the line, resting on bearings at each end so that it may be turned (rotated) inside the coil by means of a crank on one end. A U-shaped armature rests upon the magnet, embracing the coil and touching the magnet on either side of the coil. At the bend of the armature, half-way between the ends, is secured a telephonic plate of the usual size and form and provided with the proper mouth-piece. On passing a current through the coil, the armature is attached to the magnet. Now, on turning the crank, the armature is pulled slightly out of shape (drawn inward) by the rotation of the bar combined with the magnetic attraction which tends to make it cling to and follow the movement of the magnet. On breaking the current the bar is demagnetized, the armature is released and the electricity of the plate draws the armature back, the plate resuming its normal position and the armature sliding freely (less the friction) on the rotating bar. It will be readily seen that intermittent currents, as in speech over the line, are reproduced on the plate in intermittent vibrations that reproduce on the air the sounds given to the transmitting device at the other end of the line. It will be observed that this interesting form of receiver resembles the motograph described in this department in the May number of the magazine, yet it is in principle quite unlike it. In the motograph, the vibrations are imparted to the plate from a rotating cylinder by the destruction by an electrical current of the friction between the cylinder and a spring resting upon it. In the rotophone, the armature clings to the rotating bar by magnetic attraction when the bar is magnetized, and released when it is demagnetized, the friction between the bar and armature being apparently of no consequence. Like the motograph, the rotophone is of American design, and is reported to give excellent results in practice.

BRIC-À-BRAC.

Mr. Whistler's Personality.

The following facts and anecdotes concerning Mr. Whistler will be read with interest in connection with the opening paper of this number:

James A. M. Whistler was born in St. Petersburg, whither his father went in 1842 from this country, where he had had wide experience as an engineer, to superintend the works of internal improvement projected by the Russian government. He came to America, and, as his father had been, was educated at West Point. In 1855 or 1856, he went to England and soon after to Paris, where he resided for two or three years and studied with M. Gleyre. After leaving Paris he returned to England and took up his residence in London, where he has since lived. "The White Girl," sent to the Paris *Salon*, first brought him the marked attention of the public. He has continually exhibited at the Royal Academy, his first contribution being the "At the Piano." A number of his etchings were exhibited at the Hague,

THE WORLD'S WORK.

Electro-Engraving Machine.

THIS invention, constructed on the principle of the ordinary iron planer, is designed to engrave letters, designs, figures, etc., on door-plates, rings, silverware and other metal surfaces, by cutting parallel lines, in the same manner as seen in some forms of wood-engraving machines, or silver-chasing machines. It consists essentially of a moving bed, a plate on which the work to be engraved is laid, and a cutter-head carrying a chisel or other cutting tool. The piece of metal to be engraved is secured to this plate, and the cutting tool is brought down to the work, when, by turning a small hand-wheel, the work is moved under the tool and a fine line is cut in the metal. On turning the wheel the other way, the tool is raised clear of the metal, the work is returned to its first position, and at the same time moved forward the proper distance for the next cut. The distance between the engraved lines can be adjusted to suit the character of the work, and the apparatus is really a small planer, except that the return of the feed-table is not automatic, nor has it any arrangement for securing a quick return. The feed-table has also suitable arrangements for holding the work at any desired angle, and for supporting curved surfaces. The novel features of this machine consist in the addition of a pantagraph and an electrical appliance for controlling the action of the cutting tool to the engraving machine. The cutting tool is carried on an arm balanced at the center, and carrying at the other end the armature of an upright electro-magnet. This arm is so balanced that when the armature is drawn down by the action of the magnet, the cutting tool is raised clear of the work and ceases to act. The electro-magnet is connected by wires with a battery, so that, on making or breaking the circuit, the cutting tool may be thrown in or out of work at will. Near the engraving machine is placed a stand resembling a printer's "chase," and containing a set of copper-faced type representing the name, monogram, or other device to be engraved. Connecting the engraving machine and the type is a pantagraph, carrying at the end of its longer arm a small cylinder of glass, rounded on the lower end and pierced with a fine needle of metal. The types, the pantagraph, and the engraving machine are now made, by means of wires, parts of the circuit formed by the battery and electro-magnet. The glass cylinder slides freely over the types, the needle making and breaking the circuit, and thus controlling the action of the cutting tool through the magnet. In operating the apparatus the needle is brought to the end of the row of type, just above the first letter, and the cutting tool is brought to the beginning of the first line to be engraved. Now, on moving the bed-plate, the needle, actuated mechanically through the pantagraph, moves over the face of the types, and the tool at the same time cuts a fine line on the work. On passing over a type the circuit is closed, the magnet draws the armature down, lifting the cutting tool, and the work passes under it uncut. At the end of the letter the circuit is again broken and the engraving is resumed. It will be seen from this, that each time the needle passes over a letter the engraving machine ceases to work and the line is broken. At the end of each line the machine automatically adjusts itself, both for cutting the next line and moving the needle downward over the type, so that it will take a new path parallel with the first. In a short time a series of fine lines are cut in the work, with breaks at intervals, the breaks, or uncut portions, forming the letters in relief. By means of the pantagraph, the copying of the type may be done in fac-simile, or the letters may be enlarged or decreased in size at will, precisely as in copying with an ordinary pantagraph. To reverse the engraving and produce sunken letters on a smooth surface, the wires forming the electrical connections must be adjusted to cause the needle to break the circuit at the letters and close it at the spaces between them. The apparatus, though apparently complicated and requiring delicate adjustment, works easily and quickly, and copies the most intricate designs with precision. The invention is one exhibiting great ingenuity, and it would seem as if it might be applied on a large scale to regular planing machines, particularly when iron surfaces have to be pierced with openings, or have parts raised in relief, and in engraving and decorating large surfaces, as the bed-plates of engines, frames of machines, etc.

New Drawing Instruments.

A NEW ruler for assisting in drawing parallel lines employs a roller at the back of the ruler and having a gear wheel in the center and larger wheels, or tires, at the end to raise the gear above the paper. In the gear plays a worm gear, supported in a frame on the upper side of the ruler, and controlling the movement of the roller. On the top of the ruler is hinged by a spring a short lever provided with a set-screw for controlling its movement and at the end is a quadrant and a ratchet that moves the worm gear. On pressing on the lever the ratchet moves the worm gear one notch and this permits the roller to turn a certain distance. On releasing the pressure the lever springs back, holding the whole apparatus motionless. On drawing a line by the edge of the ruler the lever is touched and the roller is free to move a certain distance, and the ruler is moved back for the next line. On tracing the line the lever is touched again and the ruler is again moved exactly the same distance. By thus touching the lever between each two lines the ruler is moved an equal distance each time, making all the lines equidistant, and by touching the lever two or more times after each stroke the lines can be placed any required distance apart. In a new compass for striking out circles, a fixed point or pivot is

used and around this the compass turns freely. For small circles the compass is fitted with a ring, having a milled edge, that they may be turned by the fingers and turning the compass entirely round while the point is kept motionless by a gentle pressure from one finger. This simple device enables the draughtsman to make a large number of concentric circles without wearing a hole in the paper, as the point always remains at rest. A new style of dotting-pen for making straight lines, as for use with a compass, employs a notched wheel supported by a small frame and controlling by a lever the action of the pen. The notches cause the pen to make a mark for each notch and thus the pen marks according to the manner in which the notches are cut on the wheel. To produce a variety of traces, dots, dashes, etc., a number of wheels are provided with the apparatus, any one of which may be used at will.

Thermograph.

THE want of a cheap and reliable recording thermometer for use in hot-houses, hospitals, malt-houses and manufactories, has led to the invention of a new style of thermograph, based on the principle of the Borden pressure gauge. A hollow tube of some elastic metal is bent into the form of a semi-circle and filled with a suitable fluid and hermetically sealed. One end is secured to a frame, or stand, and to the other end, which is left free, is attached an arm carrying a lead pencil. A dial, attached to clock-work and adjusted to turn round once in twelve hours is placed immediately before the arm carrying the pencil. Paper disks of the same diameter as the dial are prepared by printing upon them a series of concentric circles and twelve radiating lines extending from the center to the edge and corresponding to the twelve hours of the dial. One of these disks is pinned on the dial and placed before the pencil so that the point rests on the paper. The fluid in the bent tube is sealed up in a temperature reckoned at zero and the pencil is adjusted on the arm so that the point will rest at the center of the disk, or zero. On raising the temperature, the expansion of the fluid in the tube tends to straighten the tube and this movement draws the pencil radially over the disk from the center (or zero) to the edge and crossing the circles that now became indicators marking the degrees of the temperature. While the clock-work is at rest the pencil traces the variations of temperature upon the disk along a single line. On starting the clock-work the pencil leaves a circular trace on the disk so long as the temperature remains constant, or if at zero, it simply makes a round dot. Changes in the temperature drag the pencil radially over the moving disk and the result of the two motions gives a curved line that is a record of the temperature, the circles marking the temperature, the radial lines the hours. The instrument is said to be strong, portable and inexpensive, and to be sufficiently delicate to record the changes of temperature caused by opening a window or lighting the gas in a room where it is placed.

Copying Process.

THE imperfections of the ordinary copying press have led to the invention of a number of appliances for copying letters, drawings, etc., by chemical and actinic means. Of these, the "blue process" and one or two others have come into general use, and are more or less satisfactory; and more recently a new chemical process, said to be cheap and effective, has been announced. Make a warm mixture of 100 grams of fine gelatine with 400 or 500 cubic centimeters of a pasty precipitate of sulphate of baryta, and when well mixed add 100 grams of dextrine and from 1,000 to 1,200 grams of glycerine. When melted, allow it to cool till just sufficiently fluid to flow, when a little may be poured into a shallow dish and allowed to harden. If this becomes quite hard and stiff, add more glycerine, and pour the whole into a shallow tin tray and let it cool. Write the letters in a thick aniline ink,—"Violet de Paris" will answer,—and lay the sheet, written side down, on the jelly-like preparation, and press it down gently for a minute or two. On lifting the paper a part of the ink will be found transferred to the jelly, when sheets of paper may be laid on the jelly and reprints taken from it. Sufficient ink clings to the jelly to give forty or fifty impressions, when the surface of the jelly must be sponged clean with cold water. The tray containing the jelly must be kept in a cool place, and if not used for a day or two must be moistened with a sponge before using. Another formula employs 100 grams of gelatine, 1,200 grams glycerine, and 500 cubic centimeters sulphate of baryta, and gives sharper impressions from the sheet of jelly; but in cleaning it warm water must be used.

Apparatus for Testing the Quality of Steel.

AN apparatus for measuring the hardness of steel by electro-magnetism, somewhat on the plan of the device for testing steel wire described in the July number of this magazine, has been recently brought out. A balance-arm scale, having a system of wheel-work for magnifying the movements of the indicator of the scale, is set up as if for weighing. At one end of the balance-arm is a holder for supporting the bars of steel that are to be examined while from the other arm is suspended a constant weight. The bars of steel to be tested, all of equal length and diameter are suspended, one at a time, in the holder at the end of the beam. A hollow coil of wire is then raised on a stand till it completely incloses the suspended bar. A current of electricity is then passed through the coil, causing it to exert a magnetic attraction on the inclosed bar of steel. The coil is then slowly lowered and the attraction pulls the bar downward, raising the weight on the other end of the beam and moving the indicator over a scale till a point is reached when the weight overcomes the attraction, when the bar is suddenly released and rises free from the coil. The highest point marked by the indicator just as the bar is released forms a standard of measurement of the hardness of the steel. Other bars of known

hardness are tried in the same way and the points where the attraction is overcome are noted, and after a few trials standards are obtained from which the hardness of steel bars may be easily estimated in the same manner.

A New Flooring.

A NEW style of flooring for hospitals, court-houses and other public buildings has been introduced, that is reported to be admirably designed to keep out dampness from cellars or the ground and, in the case of hospitals, to prevent the passage of bad air from one floor to another. Strips of oak or other hard wood from 5 to 10 cm. (2 to 4 in.) wide, 25 mm. (1 in.) thick, and from 50 to 70 cm. (12 to 20 in.) long, and having a slightly wedged section, by making the tops wider than the bottom, are prepared at a saw-mill. The floor is then covered with a layer of asphalt and while this is still hot the strips of wood are bedded close together in it with the broad side uppermost in a "herring-bone" or other pattern. The asphalt sets in cooling and holds the strips firmly in place without the aid of nails, and the floor may then be planed down smooth. It would seem as if the strips could be made in any convenient length and if well bedded in the asphalt would certainly make a dry, hard floor, proof against moisture, vermin and decay.

New Electric Lamp.

IN a new form of electric lamp, employing two carbon pencils placed upright side by side and nearly touching at the points, the wires conveying the current are passed several times round the carbons in an elliptical coil hung in a vertical plane with the carbons and thus making a support for the lamp. The design of this arrangement is to take advantage of the law that currents moving in the same direction attract each other while those moving in an opposite direction repel each other. The current through the upper part of the coil attracts the current passing the carbons at the arc, while below it tends to repel it, and this combined attraction and repulsion are so powerful that the arc clings persistently to the tips of the pencils and even rises in a bow or curve above them, thus making the arc larger and more steady.

Memoranda.

THE experiment has been made of sowing oats and wheat together with a view to obtaining a winter covering for the wheat. The seed, in the proportions of one part of oats to two parts of wheat, was sown in the fall and the oats sprang up quickly and were killed by the early frost, the stalks and leaves lying on the ground all winter, keeping the snow from blowing away and preventing the sun from thawing the frozen ground. In the spring the dead oats made a good top-dressing for the growing wheat. The crop of wheat secured on the following season was reported to be excellent, while wheat on adjoining land planted in the usual manner was of no value.

The experiment was recently made of magnetizing iron while it is being cast. A mold in the form of a bar was surrounded by a coil through which an electrical current was maintained. Refined white iron in a fluid state was poured into the mold when a curious phenomenon was observed, the molten metal in the mold being agitated very much as when hot metal is poured into a damp mold. The mold was not damp and it was thought the magnetic influence of the coil tended to repel the fluid metal toward the magnetic poles of the mold, or better, the magnetic poles of the bar formed by the metal itself. On cooling it was found that the bar was hollow for about two-thirds its length, the hollow part being largest at the center where the sides of the bar had only the thickness of paper. It is thought that by casting iron in this manner it may be possible to make permanent and very powerful magnets, but whatever the results in this direction, the experiment has another aspect that may lead to important modifications in the methods of casting hollow cylinders without cores.

BRIC-À-BRAC.

Some Quick Replies.

DR. B——, who was for many years associated with the University of Virginia, was noted for his quickness of retort, and some of his repartees, which are fading out of contemporary memory, are worthy of preservation.

Once, many years ago, being on a visit to Washington, he thought he recognized a friend in the man who was immediately before him.

"How are you?" he said, clapping the supposed friend familiarly on the shoulder.

The stranger, turning stiffly, answered with some resentment:

"My name is Hull, sir."

"I beg your pardon," said the professor. "I was looking for the Colonel."

On another occasion, as he was walking, looking intently at something in the street, a man coming in the opposite direction, and who was gazing with equal earnestness into a shop window, ran shoulder to shoulder against him. The stranger, drawing himself up with extreme *hauteur*, said:

"*Why* did you run against me?"

THE WORLD'S WORK.

Experiments in Automatic Telegraphy.

A SYSTEM of telegraphy has been recently constructed, having radical resemblances to that of Mr. Edison, described in this number. Three forms of apparatus are required. The first resembles a type-writer, the operator sitting at the key-board and touching a key for each letter. Instead of printing the letters, the machine, by means of two small lance-like knives, cuts slits of various lengths in a roll or fillet of paper. The machine feeds the paper to the knives automatically, as fast as the operator can touch the keys, or at a speed equal to the ordinary pace of the type-writer, and only requires a moderate amount of foot, steam or other power. At the same time, at the head of each message is cut in the paper the "call" for the station to which the message is to be sent. At every station on the line is a second machine designed to transmit and receive the prepared message. The fillet of paper is fed to this machine by a suitable automatic feeding device and the machine is started. The first operation is to transmit the call, not in the form of a sound or signal, but in an electrical impulse over the line that sets a corresponding machine in the other station in motion, the movement being answered by a return call from the distant station. The paper passes under dull knives that follow the surface till the slits are reached, when the blades drop into the slits and remain there so long as the slit is passing, when they slide out of the slit, each movement opening and closing the circuit over the line. At the receiving station the machine is supplied with sharpened knives controlled by the current and cutting slits in a passing fillet of paper and thus reproducing all the slits cut in the original ribbon. This ribbon is then placed in a third machine, also supplied with knives that follow the slits as in the second machine, by their movement printing on another fillet of paper the letters corresponding to each slit. This system, though apparently complicated, has the advantage of being in part automatic, so that messages may be dispatched to a distant office without attendance at the farther end, the message being automatically cut in the paper and left till a convenient time for printing. The sending of the message also gives a record of the message that may be printed whenever desired. Various ingenious appliances are also in the system for securing exact uniformity of movement in the various machines and for sending messages to particular stations on the line or to all stations at once as may be desired.

Polar Pantagraph.

THE ordinary pantagraph has been recently modified and applied to new uses by arranging the two arms side by side and connecting them by a simple system of gearing. The apparatus consists of two metallic arms secured in a small frame in such a manner that they are free to slide in the direction of their longer axis. On each is secured a rack, gearing into a pinion placed in the center of the frame that supports them. The slightest movement of one arm forward or backward, causes the other arm to move in the opposite direction, and the apparatus thus becomes a pantagraph, working always in opposite directions in the same plane. To one arm is now fixed a pencil for tracing, and to the other is secured a curved arm, turning on a pin placed in a line with the center of the pinion and the pencil. On this curved arm is carried a shorter arm, also freely turning on a center that carries the tracing point. When properly adjusted for work, the apparatus is brought up to any curved surface and the pointer moved over it, when the pencil reproduces on paper all the curves of the surface traversed by the point. The apparatus was designed for reproducing the tread of car-wheels to show the wear. It may be used to reproduce the figure of any curved surface, as the interior of bells, surface of rails, and models of irregular forms.

Regenerative System applied to Gas-light.

THE idea of heating the gas and the air needed for its combustion, on the principle of the regenerative furnace, has been tried with success in some new gas-lamps designed for large reflector lights. Three iron tubes, fitting one within the other quite loosely, are placed upright at the place where the light is to stand. The central pipe is designed for the gas, and is mounted with a gas jet. The spaces between this pipe and the two outer pipes are filled with fine wire netting designed to absorb heat, and thus form miniature regenerators. The annular space between the central gas-pipe and the second tube is open at the bottom, and is designed for the entrance of the air needed for combustion. The annular space between the second tube and the outer tube is designed for the escape of the products of combustion and also opens to the air. The entire group of pipes is surmounted by an air-tight glass globe that also serves for a shade for the lamp. On lighting the gas the globe is put on and soon becomes filled with hot air, which having no other means of escape, is forced out through the outer annular space between the tubes, and parting with its heat to the netting as it escapes. In a short time the accumulated heat spreads to the other tubes and netting, and the fresh air flowing up the interior annular space, and the gas itself becomes highly heated, and as a result, the combustion is more active and the flame larger and more brilliant. Such a system of gas-lighting, while not convenient for domestic lamps, seems to be valuable for lamps where a powerful light is needed. This lamp and the other improved gas-lamps recently brought out, are the direct outcome of the present active competition between electric and gas lighting.

In addition to the new forms of burners, a new carburetting process, for enriching the gas, is announced that promises well. The naphthaline is cast in the form of small sticks or pellets, and is placed in a vessel near the gas-lamp and designed to be heated by the flame. The enriching is said to give a bright white light, very pleasing to the eye, while the apparatus is simple, easily managed and entirely safe.

Testing Machine for Fabrics.

THE custom of testing iron, wood and other building materials, and testing wire, ropes, cables, etc., and using these tests as a measure of the commercial value of the materials, has proved to be so advantageous that the same idea is being applied to woven fabrics of all kinds. For testing the strength of fabrics, a new machine has been introduced, designed to report pulling strains from half a kilo up to 250 kilos. The machine consists of an upright standard, supporting a horizontal hollow beam of iron, containing scale levers with a brass weighing scale having a sliding weight and a graduated scale. Suspended from the weighing apparatus, is a clamp lined with leather, and so arranged, that when the end of the piece of fabric, to be tested, is clamped between the jaws the strains will be evenly balanced and distributed. Below this on the base of the machine is a roller controlled by a hand-wheel, and round this the other end of the fabric is wrapped, when, on turning the wheel, the strains are applied, and by moving the weight on the scale-beam, so as to keep it continually balanced, a point is reached where the fabric is torn apart. This point shows the breaking strain of the material. The percentage of stretching before breaking may also be found in the same manner. If all fabrics were tested in such a machine, and the breaking point carefully noted and marked on the goods when offered for sale, data would be provided which would place the money value of the goods on an exact basis.

Further Advance in Metallurgy.

ALMOST simultaneous with the improvements made in the Bessemer furnace reported in this department in the August number, comes another discovery, also employing the Bessemer converter, and effecting important changes in the methods of treating a large class of metals. The main idea underlying this discovery is found in the fact, that certain mineral substances may be used in the converter as a fuel, thus replacing coal. A little coke is used to start the furnace, precisely as kindling is used to start coal, and a charge is given to the furnace consisting in part of sulphides, and in part of siliceous ores. A current of air is forced through the furnace, when it is found the fire may be maintained indefinitely without the use of coal, by the heat produced by the rapid oxidation of the molten sulphides, so long as the proper ores are supplied to the furnace. This, in brief, is the main idea and it has opened a wide field for experiment and research. Very encouraging results have already been obtained, though with the use of comparatively inferior apparatus, and it is thought the process will lead to new methods of separating ores, to greater economy in the use of all ores containing sulphides, to the utilization of hitherto valueless and low-grade ores, and to the introduction of metallurgical processes in places where ores exist in abundance, but are valueless on account of the cost of coal for smelting. Further details of this interesting and promising discovery will be given as soon as the experiments now going on reach a commercial stage.

Memoranda.

A NEW process for making white bricks from ordinary red-brick clays employs magnesian limestone, burned, slacked and ground with the clay. The limestone, reduced to a flour, is passed with the clay through grinding-mills till it is intimately mixed, and is then passed to a brick machine, and submitted to high pressure, the bricks being dry-pressed and ready for immediate burning. The bricks are reported to be of a good color, and furnished at one half the cost of the usual white bricks.

It is recommended to add to fresh plaster of Paris from two to four per cent. of powdered marsh-mallow root, to obtain a plaster that will submit to turning in a lathe. The materials are mixed dry, when the water may be added to form a paste. The plaster sets in about an hour and becomes sufficiently hard to be cut into dominoes, chess-men, and other small articles. A larger percentage, up to eight per cent., of the marsh-mallow root increases the hardness of the plaster. To hasten the setting a little alum may be added to the mixture.

Professor Böttger, who has brought out several new metallurgical and chemical processes of value, offers a new process for bronzing iron and porcelain. The article to be coated with bronze is painted with soluble glass and the solution sprinkled over it from a sieve and then dried, when the surplus powder is rubbed off with a brush. The process is simple and is said to resist heat or washing with alcohol, and takes the burnisher readily. It would seem as if the process might be valuable in decorating stoves and iron-work exposed to the weather.

A new form of mariners' compass has two horizontal hands, resembling the hands of a clock, and free to turn round over the entire surface of the compass card, are made parts of an electrical circuit. The course of the steam-ship having been laid, the hands are brought together on either side of this point, leaving only a space of a few degrees between them. The card is still free to move in any direction, but if it touches the hands on either side, electrical connection is made and a bell rings in the captain's cabin, or in any other part of the circuit, as desired. By this arrangement any deviation by the steersman from the course laid down for him is reported by the bell that rings continuously till the ship's course is corrected.