sugar—there it is black, boiling, and hard from the action of the sulphuric acid. It is thus that we can demonstrate the presence of the charcoal, and in this way that very useful material which we call blacking is manufactured. A quantity of sugar is taken and sulphuric acid is added, and you see in what a shining state the carbon is left when it has been submitted to this process. In this way you see we can prove that the starch contains the same material.

Let me now call your attention to the history of the plant in relation to the sugar. During the germination of plants sugar occurs in great quantities. If we throw these seeds into the ground, the little embryo in the interior grows, and that process is called germination. There is a large quantity of starch surrounding this little embryo, and as it grows the starch is converted into sugar, and this starch is as necessary for young plants as it is for young children. Now this is the case, on a very large scale, in the process of malting. The maltster takes his barley, immerses it in water, causes the seed to germinate, and then he roasts the young plant, seizing the sugar which it has just made, and converts it into beer. Then again we find the stems of plants in certain seasons of the year contain large quantities of sugar; thus, the whole of the grasses, wheat, barley, oats, rye, rice, and maize, contain sugar in their stems when they are about to flower; and it is just at this season of its development that the sugar-cane is used by man as an article of diet. We need not, however, confine ourselves at all to the sugar-cane. The only reason why we get sugar from nothing else arises out of our fiscal system, revenue being obtained from it, and sugar not being allowed to be grown in this country. In China they obtain sugar from the *Sorghum saccharatum*, which, like the sugar-cane, belongs to the family of grasses, and is cultivated in the North of China for the sugar it contains. Then the maize has been cultivated in America and Mexico for the purpose of obtaining sugar. When Cortes conquered Mexico he found the natives cultivating the maize and crushing it for sugar. The cocoa-nut tree of the island of Ceylon is a principal source of sugar, and there are a class of men whose occupation it is to ascend these trees and put on the blossoms of the tree a calabash to catch the exuding juice, which is an article of diet known in Ceylon as toddy, the men being called toddy-drawers. Again, at the budding season, the sap of plants contains sugar. The common osier has it. The birch, too, in England and Scotland is tapped for its sugar, and is converted in Scotland into an effervescing wine, exactly like champagne. In America there is a plant which contains so large a quantity of sugar that I think a third of the sugar consumed in the United States is obtained from it. It is the maple. Then the beet-root, the carrot, and the turnip contain sugar. When Napoleon Bonaparte excluded cane sugar from the French markets, they set to work to supply the loss, and adopted a German process, which resulted in the production of a very successful sugar from the beet-root and now, after years of production, sugar manufacturers are enabled to compete with the manufacturers of sugar from the sugar-cane. There is also another source of sugar in the fruit which we eat,—the fig, the pear, the apple and the orange, would be unpalatable but for their sugar.

I will now draw your attention to the different kinds of sugar. Although sugar is always sweet, and we call everything that is sweet sugar, yet there are various kinds of sugar. Sugar is obtained from milk; and we can, by taking the livers of animals and digesting them in water, obtain large quantities of sugar called liver-sugar, showing that animals have the power of producing or secreting sugar. Thus we have several kinds, and I would just call your attention to the four principal sources.

The cane sugar is found in the stems of plants, and in all those cases where it is procured before the flowering of plants, and in the roots of plants; so that the beet-root sugar and the ordinary sugar that we eat from day to day is cane sugar. But we obtain another sugar from fruit, which is uncrystallizable; and that fruit sugar is almost identical with another, which is called starch sugar; and fruit sugar and starch sugar are both known to chemists by the name of Glucose. The cane sugar is called Sucrose, and the sugar obtained from milk is called Lactose, while liver sugar is called Hepatose. Those are the four sugars. I told you just now that the liver contains a quantity of sugar; I may say that I believe it has been demonstrated that the liver does not contain sugar itself, but a matter which is easily converted into sugar; so that the instant you expose it to the air it becomes converted into sugar. We have in glucose a substance much more easily decomposed than the other forms of sugar; and I will finish by stating that this cane sugar is converted into this form of sugar, and then we have either glucose, lactose, or hepatose in the system. It is in that manner that the starch is converted into sugar, so that it becomes a heat-giving substance capable of maintaining heat in the animal body.

### The Needle Women of London.

A correspondent of the London *Times*, describing one of the great mantua-making establishments in that city, communicates the following facts:—

Work is commenced every morning at 7 o'clock and continued till 11 at night—a period of sixteen hours, the only intervals allowed being about ten minutes for each meal; the total amount of time allowed for—eating their food, I was going to say, but, surely, "bolting" it is the more appropreate phrase—being forty minutes per day; thus leaving fifteen hours and twenty minutes as the period devoted to work. And this, be it remembered, is not merely during the busy season, as at the West End, but for all the year round, from January to December; for you must understand that, at the establishment to which I refer, the greater part of the sewing is given out to slop-workers in the busy season, and all that is done indoors is the original cutting out and ultimate fitting together of the separate pieces; but when the slack season comes, there is always as much sewing reserved as will keep the girls of the establishment employed up to the full pitch—so that there is, in fact, no "slack season" at all for them. And yet, for this continued and unrelenting pressure of sixteen hours' work per day, from year's end to year's end, this firm assume to themselves the greatest possible credit. They thank God that they are not as other firms are at the West End—oppressors and destroyers of young women. They never—not even for a few weeks in the busy season—make their people sit up till 3 or 4 o'clock in the morning! Oh, no!—their gas is always turned off in the workroom by 11 o'clock. Why, sir, the West End system, with its few weeks of severity, followed as it is by months of comparative leisure, is mercy itself, when viewed alongside of this unmitigated, "never-ending, still-beginning" slavery to which I am referring.

The only day of leisure which the girls of this establishment have is Sunday. From Monday morning to Saturday night, they are as complete prisoners as any in Newgate. They know not whether the sun shines or the rain falls at that time. They are not allowed to cross the threshhold even to purchase a pair of shoes or a new gown for themselves, and must employ their friends outside to do this for them.

Nor is the accommodation indoors such as in any way to reconcile them to this close confinement. The workroom, in which ten or twelve of them are employed, is only about twelve feet square, and is entirely devoid of arrangements for ventilation, which is the more to be deplored as, during the evening, they have to encounter the heat and foul air of three flaming gas burners right over their heads, every door and window being shut by which a breath of pure air could possibly enter. The bedrooms are equally uncomfortable, no fewer than six persons being huddled into one and four into another.

It is impossible to contemplate the condition of this class of workwomen, as disclosed by the facts quoted, without keenly sympathizing with it, and wishing that something might be done to mitigate its evils and misery.

A Drunkard's Brain.—Hyrti, by far the greatest anatomist of the age, used to say that he could distinguish in the darkest room, by one stroke of the scalpel, the brain of the inebriate from that of the person who lived soberly. Now and then he would congratulate his class upon the possession of a drunkard's brain, admirably fitted, from its hardness and more complete preservation, for the purpose of demonstration. When the anatomist wishes to preserve a human brain for any length of time, he effects that object by keeping that organ in a vessel of alcohol. From a soft, pulpy substance, it then becomes comparatively hard; but the inebriate, anticipating the anatomist, begins the indurating process before death—begins it while the brain remains the consecrated temple of the soul—while its delicate and gossamer-like tissues still throb with the pulse of heaven-born life. Strange infatuation, thus to desecrate the god-like! Terrible enchantment, that dries up all the fountains of generous feelings, petrifies all the tender humanities and sweet charities of life, leaving only a brain of lead and a heart of stone.

To Clarify Oil for Rifle Gun Locks.—Fill a phial three parts with almond oil, then fill up the remainder with clean lead chips. Keep the phial in a warm room and shake it now and then for a month, at the end of which time most of the mucilage and acid naturally in the oil will have combined with the lead, and thus be clarified and fit for lubricating gun locks and other similar work. The lead is easily procured in chips by cutting up with a knife a couple of elongated bullets.

## FOREIGN SCIENTIFIC INTELLIGENCE.

[Translated for the Scientific American.]

#### COAL OIL FOR PAINTING.

The products of the distillation of coal, and especially of coal tar, seem destined to rival india-rubber in the variety of their applications. *L'Invention* describes an invention of Mr. Mallet for rendering the heavy oils derived from coal applicable to painting. The invention consists in dissolving resinous or gum-resinous substances in the oils. The oil is heated in a boiler and resins are added in various proportions from 50 to 100 per cent of the oil. The solution is filtered through a woolen strainer to separate all solid matters, and is either employed directly as a coating for wood, metal and other surfaces, or ordinary coloring matters are ground in it in the usual manner. These oils of coal tar have, in the crude state a very deep brown tint, which would injure the tone of most colors. This inconvenience is, however, remedied to a considerable extent, by purifying the oils by any known process. The quality of the resins also influences the tint of the paintings, and it is necessary for certain tones to employ the qualities of which the shades are the least deep.

These paintings, or the resinous solutions alone, may be used not only on wood, but also on stones, on the coatings of mortar and plaster, and especially on tiles, flower pots, metals, and articles of basket work. Detached objects may be covered by immersing them. These resinous solutions may also be applied to render linen impermeable. In this case the quantity of resin should be small; a twentieth part being sometimes sufficient. To give more suppleness to the solution a small quantity of india-rubber may be added; it readily dissolves in the oil. Two or three coats of these paintings leave a varnish on the surfaces covered with them.

#### BLEACHING OF PAPER PULP.

The *Annales des Mines* states that Messrs. Firmin-Didot and Barruel, in their experiments on the bleaching of paper pulp by the chloride of lime, have learned that this bleaching may be effected by means of carbonic acid. The carbonic acid gas is introduced into the liquid which contains the chloride and the matter to be bleached; it displaces the hypochloric acid. The generator of carbonic acid may be a furnace; the gas in this case being purified. It passes through three washing reservoirs in part filled with water, a refrigerator, and a purifier provided interiorly with a lattice work of osier covered with wool and with damp moss to arrest all the dust. Beyond this purifier is an air pump, which, after having drawn the gas through the preceding apparatus sends it through a last washer into a supply tube. Pipes, furnished with stop-cocks, lead from this tube, each of them communicating with a worm pierced with holes and placed at the bottom of the bleaching tubs. The carbonic acid is thus distributed as needed, in the same manner as steam is distributed.

#### THE PRESERVATION OF MEAT BY MOLASSES.

In many receipts for preserving hams, molasses is one of the principal ingredients, but Mr. Marguerittе, in an article in *L'Invention*, asserts that meat may be preserved by molasses alone in the most perfect manner, and with the following important advantages: It has an agreeable flavor, it produces no scurvy or other disorders which result from the use of salt food, and it may be prepared at a moderate price.

The process consists simply in cutting the meat into pieces of moderate size and dropping them into molasses, such as is obtained from the sugar manufactories or refineries. By a natural process of osmose the lighter juices of the meat pass out, and the heavier molasses penetrates inward to every part of the meat. When the external molasses has acquired a certain degree of liquidity from the mixture of the juices of the meat, it is a sure sign that the meat is thoroughly impregnated. It is now taken out of the molasses, thoroughly washed, and hung in a current of air to dry. After it is completely dry, it may be packed in boxes and sent all over the world without experiencing any change whatever.

#### NEW ALLOY FOR SOFT SOLDER.

We find in *L'Invention* directions for preparing an alloy for a very soft solder, which that journal says has the following very valuable properties. It attaches itself very strongly, not only to metallic substances, but also to glass and porcelain; at a temperature of 700° Fah. it is as soft as wax, but in ten or twelve hours it becomes so hard as to take a polish like silver; and it unites metals so firmly that they may be worked in any manner whatever. As its bulk is not altered by its hardening, it fills perfectly any channels, crevices or joints into which it may be introduced.

It is prepared as follows: Perfectly pure copper is procured, either by reducing the oxyd of copper by means of hydrogen or by precipitating the metal from the sulphate of copper with zinc turnings. Either 20, 30 or 36 parts of this pure copper, according to the hardness of the alloy desired—the more the copper the harder the alloy—is moistened thoroughly in a cast iron or porcelain mortar with concentrated sulphuric acid (at 1.85 density); then to this metallic paste is added 70 parts, by weight, of mercury; the mixture being constantly stirred during the addition of the mercury. When the copper is completely amalgamated, the composition is washed with an abundance of boiling water to remove the sulphuric acid. The composition, at first soft, becomes in ten or twelve hours so hard as to take a fine polish, and to scratch gold or tin. It may at any time be made as soft as wax by heating it to about 700° Fah., or by triturating it in a mortar at a temperature of 260°. If, in this state, it is placed between metallic surfaces free from oxygen, it will unite them so firmly that they may be wrought in any way without separating.

SPIDERS.

A learned entomologist, who has made a special study of the structure and habits of spiders, states that there is not a single authentic case on record of a person being killed, or seriously injured, by the bite of a spider; all the stories about the fatal bite of the famous tarentula being simply fables. These insects are, however, exceedingly ferocious in their fights with each other; their duels invariably ending in the death of one of the combatants. In some species, the first step of the young as soon as they are hatched is to eat up their mother.

## ELECTRICITY AND SOME OF ITS PRACTICAL APPLICATIONS.

ARTICLE III.

The construction of the electro-magnet, and its application to the telegraph, are fully treated in a number of works, but of late the application of electro-magnetism to the production of rotary motion —or, indeed, of any useful mechanical effect—has received but little attention, and we know of no work which treats the subject in a thorough manner.

A great number of magnetic motors have been invented, none of which have ever come into practical use in this country, although it is reported that in France a few are in use for purposes requiring certain motions.

All, or nearly all, the electro-magnetic machines constructed have made use of one or more of the following powers:—

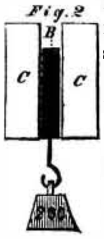
1. The attraction of a coil or helix.

2. The alternate attraction and repulsion of opposite and like poles.

3d. The attraction of an electro-magnet for soft iron.

Probably the first engine operated by the attraction of a coil was that of Dr. Page. The principle of this engine is as follows: A coil of insulated wire possesses powerful magnetic properties when a current passes through it, and if a coil be made in the shape of a tube or with a hollow cone, it will communicate magnetic properties to a bar of soft iron placed within it, and if the current be sufficiently strong, the bar will be suspended without any material support. The cut

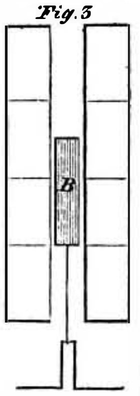
Fig. 2




represents a section of such an arrangement. C C represents the coil, and B the suspended bar. If, while the bar is in this position, the current be stopped, the bar will instantly fall out, and, when entirely without the coil, no attraction will take place; but if it be inserted part way, and the current then passed, it will be drawn wholly within. Thus, it will be seen that, by alternately breaking the current and allowing it to pass a reciprocating motion can be given to the bar, and, by means of a crank, a rotary motion may be communicated to any appropriate machinery. Such a device, however, would only exert its power through half of the stroke; but by using two coils drawing alternately in opposite directions, a constant power may be exerted throughout the stroke.

The cut represents a section of an improved device

Fig. 3




invented by Dr. Page, in which a number of coils are used, piled upon each other, and so arranged that, as soon as one coil has attracted the bar to its full extent, the current shall be transferred to the one next to it; and so on for half the stroke, when the current is to be transferred to the other side of the bar, when it will be attracted in the opposite direction through the return stroke. This beautiful device has as yet failed to come into general practical use.

The invention of machines which are operated by the alternate attraction and repulsion of opposite and like poles has cost an immense amount of time and money, but such machines are liable to difficulties which render them impracticable upon a large scale.

Engines which are operated by the direct attraction of an electro-magnet for iron may be divided into two classes—reciprocating and rotary. Reciprocating engines are entirely impracticable upon a large scale, for various reasons, the principal of which are:—

1. The extremely small distance through which magnetic attraction is exerted.

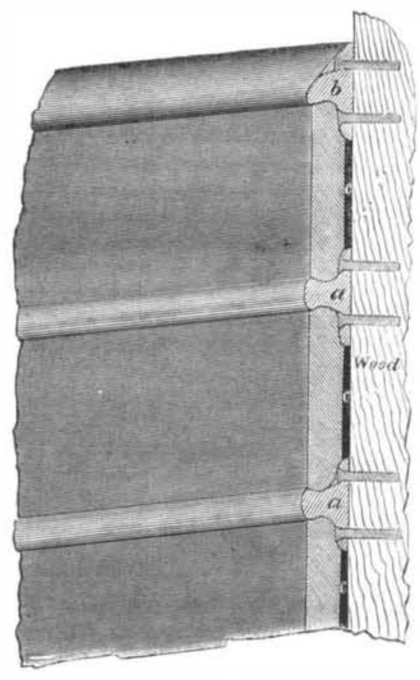
2. The waste of power by such an arrangement; and,

3. The large amount of friction to be overcome at each stroke.

These objections refer chiefly to engines in which only two magnets are used. Such machines form a part of every well-appointed philosophical apparatus.

## IMPROVEMENTS IN PLATING SHIPS OF WAR WITH IRON.

As the great interest in protecting naval vessels with shot-proof plates, which now prevails in England and France, is doubtless destined to be also felt in this country, we present the accompanying illustration from the London *Mechanics' Magazine*, as an indication of the present state of the art in England.




These improvements have been invented by T. W. Plum, Esq., of Blænavon Iron Works, Monmouth, England, and of which the following is a description:

For shielding ships and batteries on land or floating with thick metal armour plates, metal ribs are used with a flange or flanges through which they are to be bolted to the ship, battery, or other structure, and a dovetailed or T head rib for holding the plates. The flang and dovetailed ribs *a a b* may be of the forms shown in the engraving or of any similar form, so that there be a flang or flanges for bolting through, and a transverse head having more or less of dovetail shape, in order that when the plates, which are to be prepared to fit the ribs, are inserted between two of such ribs, they will be securely held in their intended position; that the plates when fixed shall cover the bolt holes, and that the joint or joints of junction between the plates and ribs shall have a tendency to tighten when struck.

In preparing the ribs, except the first, to be fixed to any structure, the bolt holes on one side of the flanges of the ribs are to be made longer, *i.e.*, oval in form in the transverse direction of the rib, so as to admit of the second and successively fixed ribs being in the first place bolted through the elongated bolt holes far enough from the rib previously fixed, to allow the plates to be inserted between them without difficulty; and the rib to be then drawn by cramps or other known means tightly to the plate; the row of bolts on the other side of the rib are then put in and made fast.

The upper and lower and vertical end ribs are made with one side only prepared to receive or hold plates, the other being rounded, moulded, or beveled off in any suitable shape, as at *b*.

The space between the back of the plates and the face of the ship or other structure shown at *c c c* may be more or less according to the dimensions determined for the ribs and plates, and may be filled with any material that may be found most suitable.

### The Joint Action of Labor and Capital in Producing Wealth.

If a man is cultivating corn with a hoe, the hoe is capital. It is the saving of previous labor, and it facilitates his industrial operations, and these are the characteristics of capital. Nearly all active capital may be properly regarded as *tools* to work with. There is a regular gradation in implements from the simplest knife or ax up to the most complicated machine or the largest manufactory. There is no place in the ascending scale where a line of distinction can be drawn, and these implements are, in fact, essentially of the same character—they are all tools in the hands of industry.

There is capital, however, which cannot be regarded as of the nature of tools. Besides his hoes, plows, wagons, &c., a farmer must have food to eat and clothes to wear while raising his crops, and this food and clothing have been accumulated from previous labor, and are therefore capital; they aid the operations of labor, and are therefore active capital.

Men everywhere work with tools; consequently all wealth is the product of the joint operations of labor and capital. When Eve determined to sew some fig-leaves together, her first step was to procure a thorn or some other implement to work with, and that thorn was just as really capital as a Grover & Baker sewing machine, or the manufactory in which those machines are made. It is a curious fact that in the very first industrial operation of the human race, the first step was to procure the necessary capital.

### Shoeing of Cavalry Horses.

The following circular has just been issued from the Horse Guards by the Adjutant General of the British army.

SIR:—It being very desirable that a uniform system of shoeing should be established in the cavalry, and the whole of that important subject having been recently referred to the consideration of a Board composed of officers of great experience in that branch of the service, assisted by two old and experienced professional men, the General Commanding in Chief has been pleased to direct that the following instructions, extracted from their Report, and which embody the whole of their recommendations, be circulated throughout the cavalry, accompanied by duplicates of the pattern shoes, which have been sealed and deposited at the office of Military Boards for general reference and guidance.

1. The shoe is to be beveled off, so as to leave a space and prevent pressure to the sole.

2. It is not to be grooved or fettered; but simply punched and the nails counter-sunk.

3. Calkin is to be applied to the hind shoe only, and is to be confined to the outside heel. The inside heel is to be thickened in proportion.

4. The weight of the shoes is to be from twelve to fifteen ounces, according to the size of the horse.

5. As a general principle, horses are to be shod with not less than *six* nails in the fore and *seven* in the hind shoe; nor is this shoe to be attached with not fewer than *three* nails on either side.

6. In preparing the foot for the shoe, as little as possible should be pared out, and the operation should be confined to the removal of the exfoliating parts of the sole only.

7. Both the fore and hind shoes are to be made with a single clip at the toes.