to retard the motion of the piston, and opposes to it a continually increasing resistance, retarding it more and more rapidly up to the center line, at which point it begins *by a continuance of the same force*, to urge it in the opposite direction. The strain of the piston on the crank, in either direction alternately, begins insensibly at the mid-stroke, culminates on the center, and diminishes to nothing at the mid-stroke again, and this resistance, at its culminating point, is the centrifugal force which the mass would exert, if it were revolving instead of reciprocating; and at every other point is the horizontal component of that force.

This is readily established. First, the direction of the force is radial. Second, the coefficient of centrifugal force is the decimal, ·000341, which is the centrifugal force (in decimals of a pound), of one pound, making one revolution per minute, in a circle of one foot radius. This coefficient shows the centrifugal force of 1200 pounds, making 122·3 revolutions per minute, in a circle of 1·25 feet radius, to be 7650 pounds.* Third, this identity is practically proved by the fact that the reciprocating parts are balanced, in the horizontal direction, by an equal weight, revolving opposite to the crank, and at the same distance from the center. Fourth, an examination into the nature of the force itself shows that it *is* centrifugal. What is centrifugal force? It is the resistance which a moving body offers to being deflected from a right line, or, as it is radially at rest, its right line of motion being across the radial line at right angles, it is its resistance to being put in motion, towards the center, from a state of rest, and the amount of this motion is the versed sine of the angle, a definition which exactly describes the force under consideration.

But what is the influence of this action upon the problem of high piston-speed?

We see that it makes any engine, in effect, a rotary engine if the steam be shut off, the crank passing the centers under the strain of the centrifugal force of the reciprocating parts. But at ordinary speeds this force is developed only in a small degree, varying from 2 pounds to 10 pounds for each square inch of piston area, and of course the force of the steam is only to this extent expended in overcoming it, the excess becoming, at the instant of its admission, effective against the crank.

Nor, at more rapid speed does it become of marked value, unless considerable weight in the reciprocating parts and a short stroke be employed, since it increases directly as the mass, and inversely as the diameter of the circle, with a given piston-speed. By combining, however, rapid speed and short stroke with considerable weight in these parts, their centrifugal force may be developed to whatever extent we choose; and if this be in excess of the force of the steam, the engine, with the steam turned on, becomes, in effect, a rotary engine. The crank passes the centers under a strain not wholly relieved; the force of the steam does not reach the crank at these points, but is absorbed in the mass, and is afterwards gradually imparted to the crank during the stroke.

It is certainly difficult to estimate too highly the value of this action. By means of it, the shock of the steam on the center may be avoided wholly, or in any degree; the excessively intermittent pressure caused by working steam at a high grade of expansion is transformed, as by magic, into a steady and uniform rotative pressure on the crank; the fly wheel is relieved of its most trying offices, and the shaft from the excessive torsion in alternate directions that is produced by its action; and a smooth and gliding movement is attained, with a closer approximation to uniform motion than the crank has been supposed to be capable of giving.

It is curious to observe how exactly opposite to the truth all the engineering traditions on this subject turn out to be. We have been taught that the reciprocating parts of an engine were passive on the centers, that the great difficulty encountered in the attempt to employ high speed was the necessity of reversing their motion, that they should therefore be made as light as possible, and long strokes should be employed, so that the changes in the direction of their motion might be as few as possible. Now we know that their centrifugal action on the centers is all important to a high speed engine, and that to render this most serviceable we must employ considerable weight and a short stroke.

The field is a very large one; I limit myself to the fundamental principle which I have endeavored to explain. This being established, all theoretical objection to the employment of high speed vanishes. When the dead center is stripped of its imaginary terrors, we must perceive the dawn of a new day in the history of the steam engine.

* This furnishes us a simple rule for calculating this force. Multiply together the weight of the reciprocating parts, the length of the crank in feet, and the square of the number of revolutions per minute, and multiply the product by the decimal ·000341.

Sulphuric Acid from Gypsum.

As is well known, numerous attempts have been made to procure sulphuric acid from the widely-distributed gypsum, or sulphate of lime; but hitherto without success. Some time ago it was stated that dolomite, a mineral consisting of carbonate of magnesia and lime, may be decomposed by gypsum—carbonate of lime and sulphate of magnesia (bitter salt) being produced when they are both mixed as fine powders and lixiviated with water. From the latter the sulphuric acid can be readily separated by chloride of sodium, the concentrated solution of both yielding sulphate of soda and chloride of magnesium. In the *Neue Jahrbuch für Pharmacie*, 1870, page 204, H. Reinsch denies that gypsum can be decomposed by dolomite. He prepared an intimate mixture of the powdered minerals, and treated it for three months with water, allowing the liquid to drop from a filter, but without even obtaining a trace of bitter salt. After this time he kept the mass boiling for three days, the waste of water by evaporation being constantly re-supplied. The filtered liquid, being boiled down, left a yellowish cake, consisting of two thirds gypsum and one third of other salts, as nitrate of magnesia, chloride of magnesium, nitrate of lime, and traces of bitter salt. Hereupon Reinsch made trials in another direction. He mixed two parts of powdered gypsum with one part of carbonate of ammonia, which contains one and a half equivalent of ammonia. Upon being triturated with water, a liberation of gas took place which lasted for several days, and as the liquid was ultimately heated to the boiling point, a very vivid disengagement of pure carbonic acid was produced. By this process, carbonate of lime, and sulphate of ammonia were formed, and part of the carbonic acid of the ammonia salt was disengaged as gas.

The gypsum was completely decomposed. At the ordinary temperature the decomposition takes place without interruption, but slowly, while at the boiling point it becomes very rapid. A very soft carbonate of lime is thereby obtained, which, in large quantities, might certainly be utilized. In order to separate the sulphuric acid from the ammonia salt, it would only be necessary to subject it to sublimation with common salt, and to convert the resulting chloride of ammonia with carbonate of lime into carbonate of ammonia. It is thought probable that this method of producing sulphuric acid may be carried out on a large scale, provided that the carbonate of lime formed during the first decomposition, and the chloride of calcium formed at the second one, can be utilized, of which, according to Reinsch, there cannot be any doubt.

The chloride of calcium, at least, has repeatly been recommended as a means for keeping streets free from dust. In this manner the inexhaustible sources of gypsum could be employed for the manufacture of sulphate of soda, which forms the basis of the fabrication of glass and soda.

Correspondence.

The Editors are not responsible for the opinions expressed by their Correspondents.

Beams and Girders.

MESSRS. EDITORS:—Mr. Severson, in the SCIENTIFIC AMERICAN of Dec. 10, last, criticised me freely on the subject of the strength and strain of beams, etc., which is all right; but I am sorry for the reputation of the profession to which he attaches himself, that he should make so many blunders in so short an article. He evidently does not belong to that class of engineers to which I referred in a former article, for he differs from all of them, in every point he advances.

It will be observed that, on page 307, SCIENTIFIC AMERICAN, Vol. XXIII., I assumed two positions, differing from those advanced by the *Builder*. The first, which was in relation to the strain to which a beam is subjected by a weight laid upon it at different points between the supports, is expressed by the following formula or general proportion:

$$A \text{ varies as } BC \times CD$$

in which A is the strain to which a beam is subjected, by a weight laid on it, at any point, and BC and CD are the segments of the beam between this point and the supports. For authority see "Gregory's Mathematics," art. 2, page 402; "Practical Book" of reference, by Chas. Hazlett, and Prof. Hackley, of Columbia College, page 265; "Scribner's Engineer's and Mechanic's Companion," page 129, Note 1.

The second relates to the strength of beams, and is expressed by the following general proportion:

$$S \text{ varies as } \frac{bd^2}{l}$$

in which S equals the strength of the beam, b the breadth, d the depth, and l the length. See "Scribner's Engineer's and Mechanic's Companion," page 127; "King's Notes on Steam," art. 3, page 207; "Gregory's Mathematics, art. 22, page 405; "Mahan's Engineering," first equation on page 387; reports of Du Hamet and M. de Buffon, to the French Government, as given by Robert Stuart in his "Cyclopedia of Architecture," article, "Mechanical Carpentry."

Yet, in the face of all this authority, our friend Benjamin Severson, mechanical and civil engineer, of Washington, D. C., is bold enough to tell us, with regard to the first of the above propositions, that the strain varies "inversely as the distances." And with regard to the second proposition, that "the positive statement of Mr. Pearson appears to be equally erroneous."

Again, in attempting to enlighten us upon the "strain of beams," resulting from a load laid evenly over the whole length, he says: "Under loads thus uniformly applied, the strains increase as the squares of the spans." While all the authorities above quoted unite in telling us that the strain at any point of a beam, resulting from a load thus evenly laid over its entire length, is only the half of that resulting from laying the entire load on that particular point.

Again, in relation to his hypothetical beam, it is no disparagement of the formula that the beam will not support its own weight. It will be seen that the element of weight varies directly as the length, while the element of strength varies inversely as the length, the other dimensions remaining constant, so that it is possible for a beam, having all the strength assigned to it by the formula, to fail of supporting its own weight.

Furthermore, it will be seen by reference to his article on page 372, Vol. XXIII., SCIENTIFIC AMERICAN, that all his deductions are from appearances. He does not give the result of any experiment, or any analytical investigation, or quote any author in support of his sayings. It takes something more than simple appearances to do away the results of profound research for ages. H. C. PEARSONS.

Ferrysburgh, Mich.

Fire Escapes.

MESSRS. EDITORS:—In a late issue of your valuable paper, one who signs himself "Humanity" suggests the idea of an apparatus to save persons from the horrible death of burning alive, as was the case at the burning of the Spotswood House, at Richmond.

The idea is a good one, but instead of a rope basket, as he suggests, two baskets, made of wire, should be used, one inside of the other. The outside one must be made of wire gauze $\frac{1}{20}$-inch mesh, or sufficiently fine to prevent a flame from passing through, yet, at the same time, allowed full circulation of air. The inside basket should be made less than the size of the outside one, allowing from two to three inches space between the two, and of wire $\frac{1}{4}$-inch mesh. Both should be placed on iron frames. To this should be attached a small iron chain, sufficiently long to be used by parties outside of the building, on the ground, in hoisting and lowering. A small pulley block and hook should be attached to the chain.

About the building in several places should be placed iron brackets with rings suspended to hook the blocks to in case of need. The principle of the basket is well understood to be that of Sir H. Davy's miners' lamp. It could be lowered through any amount of flame without the least fear of a person's clothes inside taking fire. These baskets would also be handy for firemen to use in case of fire, provided they were not wanted for other purposes; and the cost of placing them about a building would be merely nominal.

376 Broadway, Boston. M. H.

"Men of Progress."

MESSRS. EDITORS:—I feel I must acknowledge the receipt of the splendid steel engraving. For art and beauty, it far surpasses my expectations. I look on it as a piece of work pretty hard to beat.

I have been striving to establish the SCIENTIFIC AMERICAN in this place; and I think, henceforth, it will speak for itself. I have yet to hear any one say that the SCIENTIFIC AMERICAN is not a good paper. R. M. HUMPHREYS.

Tarentum.

Discovery and Invention.

The genius of the inventor is frequently undisciplined by culture; he is perhaps a workman of slender means and narrow views; hence the overpowering force with which his one idea seizes him. The discoverer, on the contrary, he who enlarges the boundaries of knowledge by important truths, must be both a genius and a scholar, a man of broad views, many-sided, healthy, up to the level of science in his time. Such conditions almost presuppose pecuniary independence. Hence, in reading the lives of the great lights of science—Pythagoras, Archimedes, Copernicus, Newton, etc.—we generally find them men of standing and influence, men who have leisure enough to devote themselves to science, and education enough to bring all varieties of existence within their ken. For want of this thorough scientific training, inventors are continually forced to test every step of their work; and it may be that only after hundreds of failures any success is achieved. Though, as Mr. Smiles says, "the steam engine was nothing until it emerged from the state of theory, and was taken in hand by practical mechanics," it must be remembered, also, that without theory it could never have been thought of, and that ignorance of scientific truths is often the most serious hindrance to practical men in their inventions. If Goodyear had known that oil of vitriol contained sulphur, he might have been able to utilize india-rubber in three years, instead of ten, after he had made that the purpose of his life. He found that oil of vitriol (he did not know it by the name of sulphuric acid) would sometimes produce upon the pure gum the very effect that he wanted, and he wasted time in numerous experiments trying to render that effect permanent, when a chemist would have suspected that the sulphur in the acid was the real agent, and have taken the steps at once that Goodyear took years later.

Perhaps the greatest, the most complete and powerful mind among men, is that of the man who is at once a great discoverer and great inventor. Archimedes, Newton, and Franklin are illustrious examples. The ancients attribute to Archimedes more than forty mechanical inventions, prominent among which is the endless screw, which he thought out while traveling in Egypt, reflecting on the necessity of raising the water of the Nile to points which the river did not reach. He likewise applied it as a pump to clear water out of the holds of vessels, to launching ships, and to propelling them through the water, a use which is still retained. The precision with which he directed his thoughts to the attainment of any desired result is well shown by his detection of the fraud practised on Hiero, King of Syracuse, by a goldsmith to whom the king had intrusted a certain weight of gold to be made into a crown. The king suspected, when he received the crown, that the gold had been adulterated, and he applied to Archimedes for a test. The difficulty was to measure the bulk of the crown without melting it into a regular figure. It was of the proper weight; hence, if any alloy had been substituted for a part of the gold, the bulk would be necessarily increased. Archimedes kept the subject continually in his thoughts, and the conditions of the problem became so clear to his mind that when he stepped into a bath one day, the vessel being full and water flowing over, he comprehended in an instant that the amount of water flowing over was equal in bulk to the body immersed. It followed at once that if the crown would displace more water than an equal weight of pure gold, it had been fraudulently adulterated. Without a moment's delay he jumped from the bath and ran to his own house, crying triumphantly, "Eureka! Eureka!" Yet, notwithstanding his ability in the application of scientific principles, he regarded his inventions as contributing far less to his glory than the additions which he made to speculative truth. "He was half ashamed," says Lord Macaulay, "of those inventions which were the wonder of hostile nations, and always spoke of them slightingly, as mere amusements, as trifles in which a mathematician might be suffered to relax his mind after intense application to the higher parts of the science." He knew the superior value of his purely theoretical pursuits as mental discipline, and as indications of mental power. Hence he requested that his memory should be perpetuated as far as he could determine the manner of it, by his discovery that a sphere is exactly two thirds of its circumscribing cylinder; and, accordingly, a sphere inscribed in a cylinder was sculptured on his tomb.

Before quitting this subject, it may be well to notice the fact that inventions are largely based on the state of knowledge at the time, and are consequently often claimed by several persons who have worked independently of each other. Invention is at once the cause and the measure of civilization. When the world was ripe for printing, printing was accomplished, either by Koster, Gutenberg, Faust, or Schœffer. When the telescope was needed, the telescope must be invented, whether by Hans Lippershey or Galileo. The honors of the steamboat are disputed, and claimed by almost every civilized country under the sun. A want thoroughly felt tends to bring out its supply. It would be interesting to look over the records of the Patent Office, to find out in what year the people of the United States felt most keenly their need of improved mouse traps, and when the imperfection of their coffee mills became a burden. Even in these things, demand regulates supply, and anxiety for perfection in the merest trifles is an indispensable condition of progress.—*Am. Ex. and Review.*

Burning and Unburning.

Abstract of a lecture by Dr. William Odling at the Royal Institution, London.

Dr. Odling began by explaining the first principles of combustion, and showing the simplest methods of lighting a match. When speaking of the old method of obtaining a light by means of flint and steel, he exhibited the "steel mill" once in common use among English miners, to give them just enough light to proceed with their work. It consisted of a little steel wheel driven by multiplying gear, and made to rub against a piece of flint; by this method a continuous shower of sparks could be kept up. He then exhibited the old method of obtaining a light by means of a piece of bent steel, one part of which was allowed to hang down over the knuckles of the left hand, and this part was struck with a piece of flint held in the other hand. With each blow a few sparks were struck off, and these sparks were allowed to fall upon carbonized rags, better known as "tinder;" the tinder at once began to smoulder; this smouldering was increased by blowing; so that at last there was ignition enough to set fire to a splint of wood, the end of which had been previously coated with sulphur. The lecturer remarked that on a cold winter's morning this tedious method of obtaining a light was a very serious thing. He then showed some of the more recent methods of producing flame, and among others he lit the gas jets of the theater of the Royal Institution with sparks of electricity.

The lecturer then spoke of ordinary examples of combustion, such as is seen in gas flames, candle flames, and the household fire; he pointed out that coals, candles, and other substances gradually disappear as they burn, and he asked, "Where do they go to?" An ordinary sperm candle while burning loses in weight about two grains per minute, and it burns down at the rate of one inch per hour. All this burning, however, goes on in common air; exclude the air and the fire soon goes out, as it unites with the one fifth part by volume of oxygen gas contained in common air. To illustrate this Dr. Odling took a very large glass tube, full of air, into which he poured a small quantity of a strong solution of pyrogallic acid and a little caustic potash; thus a solution of pyrogallate of potash was formed. He then closed the end of the tube, and shook up the liquid inside it; consequently, as fresh pyrogallate of potash absorbs oxygen with very great avidity, the solution took up all the oxygen contained in the air in the tube, reduced its bulk by one fifth, and left nothing in the tube but pure nitrogen. This nitrogen, he then proved by experiment, would not support combustion.

Dr. Odling pointed out that, although mercury does not oxidize in the air at ordinary temperatures, it rusts very slowly when it is kept at a high temperature, and then it changes slowly into red oxide of mercury. Dr. Odling applied heat to red oxide of mercury contained in a tube, and thus drove off the oxygen once more; he mixed the oxygen thus made with five times its bulk of nitrogen, then proved by experiment that the resulting mixture had all the properties of common air.

In another experiment he proved that the chief products of the combustion going on in a candle flame were water and carbonic acid gas; a common sperm candle, weighing 2¾ ounces, produces in burning no less than 3¼ ounces of water, or more than its own weight. The additional weight of the product of combustion is, of course, due to the oxygen taken from the atmosphere.

At the close of this lecture Dr. Odling exhibited the ignition and combustion of the metals—silver, cadmium, zinc, and thallium. A hollow was scooped in the top of the lowermost carbon point of the electric lamp, and in this hollow a piece of silver was placed; when the upper carbon point was allowed to touch the silver, the electrical current quickly raised the silver to boiling temperature, and on separating the points, a broad brilliant arc of vapor of silver played between them. This phenomenon, magnified by the lenses of the electric lamp, was projected upon the screen, forming a beautiful green luminous arc, apparently about six feet long. Cadmium gave a more subdued bluish green light, and the solid oxide was seen to assume curious network forms upon the lower carbon point. Zinc burnt with a purple flame. Thallium gave a magnificent green arc of very considerable length.

Dr. Seyferth's Process for the Purification of Sirups and Molasses in the Manufacture of Sugar.

The juices and liquors employed in the first extraction of sugar from the raw material it is contained in, as well as the sirups resulting from the sugar refining processes, all generally contain a certain quantity of alkaline substances, varying, however, in quantity with the various conditions of the soil on which the beet roots have been grown and the mode of cultivation. The juice of the ripe sugar-cane, however, is at the moment of being squeezed out of the cane slightly acid to test paper. By treating the saccharine juices with milk of lime, several of the bases of the alkaline salts present in the juices are separated from the acids they were at first combined with, and by thus being set free and remaining mixed with the sugar, impede its crystallization. One part of alkaline matter can absorb as many as four parts of sugar; and some kinds of molasses (chiefly from beet root) contain as much as 8 per cent of alkali.

The means hitherto tried to remedy this defect; namely, neutralization of the alkalies by acids, have failed in practice, chiefly for two reasons—first, because the acids have not been applied at such a stage of the process of manufacture as to enable the acids to seize upon the whole of the alkalies; and secondly, because it has never been possible to prevent the injurious effect of even a very slight excess of acid upon the sugar itself; while, moreover, a difficulty is encountered by the very variable quantity of alkali present, whereby the proper quantity of acid to be applied varied every moment, thus rendering its application totally unsuited in any but very skilled hands. Among the acids applied, sulphuric and phosphoric have been most used, but their use could not but be very limited, since even a very slight excess of acid was far more to be dreaded, on account of its highly injurious effects upon the sugar than almost any amount, so to say, of alkalies. Sulphurous acid has been used and recommended in various forms, even as far back as 1810 (Proust), both on account of its activity as acid in saturating alkalies, as well as its power as a bleaching agent, by thus rendering the sugar more white-colored.

Dr. Auguste Seyferth, managing director of the Brunswick sugar (beet root) refinery, has hit upon a plan for the use of sulphurous acid, which (according to the unanimous and unbiased testimony of no less than one hundred proprietors of establishments wherein the processes invented and brought out by the doctor, since September, 1869, are applied) answers the purpose admirably, yielding more produce and of better quality in every respect.

The process alluded to consists essentially in the introduction of sulphurous acid, either in gaseous form, or in very weak aqueous solution, into the vacuum pans. By this arrangement it is possible to bring all particles of the sugar solution (sirup) into contact with sulphurous acid, and to eliminate, by the joint action of heat and vacuum, any excess of the acid, which, however, not only saturates free alkalies and carbonate of lime, but also sets the organic acids, which might be present as alkaline salts, free from these combinations; the sulphurous acid taking hold of the bases they were combined with, while the greater part of these organic acids are volatilized along with the steam, and thus the sulphurous acid promotes the good and ready crystallization of the sugar, while its action as a decolorizer comes also advantageously into play.

The Seyferth process embraces two main operations; namely, the manufacture of the sulphurous acid as gas, or as aqueous solution, and the application of the acid (chiefly in aqueous solution, being more readily manageable) and its introduction into the vacuum pans. The sulphurous acid is manufactured at the works (beet-root sugar manufactories or sugar refineries) by the well-known expedient of burning sulphur in suitably constructed ovens, and carrying the products of combustion, previously cooled so as to condense any vapors of sulphur, into a leaden vessel wherein the gas is met by a suitably arranged current of water so as to become entirely absorbed.

The aqueous solution thus obtained is put into casks, or other suitable vessels, and from these a tube, provided with taps, leads to the vacuum pans, wherein the liquid is sucked simultaneously with the sugar solution. The party in attendance upon the boiling in the vacuum pans, while causing the sulphurous acid to be aspired, takes care to test from time to time (this is done by means of a contrivance technically known as proof-stick) the contents of the pan by applying blue litmus paper, so as to insure the contents of the pan remaining alkaline; but if by a mishap the acid is in excess this is remedied by sucking in a fresh quantity of sugar solution, while a slight increase of the rapidity of evaporation (the turning on of more cold water to the condensers) will rapidly eliminate and volatilize any excess of sulphurous acid, which, when in quantities of 50 to 100 kilos. excess of the weak solution, does not affect the sugar.

The quantity of sulphurous acid solution applied varies from 4 to 8 or from 10 to 15 per cent of the bulk of liquid (sirup) to be evaporated, but these figures are not absolute, but only relative, since experience has already proved that the requirements differ for different localities. The process alluded to is stated to possess, besides the advantages already named (production of better quality and larger quantity of sugar) the good qualities of being applicable at very little cost; to require no inconveniently large space; to be applicable to any already existing manufactory without causing any temporary stoppage of work; and its application is readily learned by the sugar boilers.

According to communications made on this subject by the members assembled at the general meeting of German sugar manufacturers and refiners, at Berlin (last May), and a similar meeting lately held at Prague, this process is highly appreciated, and largely eulogized as an immense improvement in this branch of industry.—*From the London Artizan.*

Sewing and Cooking.

Says the *Journal of Gas-lighting*: A French lady has been calling attention to the deficiencies of the working and lower middle classes in sewing and in cooking. Cooking seems, like music, a gift of certain nations. The French have it in perfection, stimulated by poor food and dear fuel. Italian cookery is atrocious; and German, where unimproved by French contact, greasy and unsavory. It is much to be desired that some of the fervor directed towards making women fit for physicians and barristers were directed to making them good wives and mothers. There may be exceptions, but we have never come across a charity school where even the principles of cookery were taught. While a smattering of superficial knowledge is distributed, the girls never get a good lesson on "the difference between simmering and boiling!" There is no sewing in our workhouse schools to be compared with that turned out of the convents of Belgium and France. Indeed, we should say that in the female orphan asylums round London more attention is paid to a parrot-like instruction in religious phrases than to any useful knowledge. Many of the girls turn out hypocrites; most of them, from the severity with which they are treated, liars; but it is very rare to hear of the manufacture of a good governess or a good domestic servant. The model prize girls are often female samples of Uriah Heeps. There is no reason why cookery should not form part of the daily education of every girl above eight years old who has to get her own living, or whose husband has to get his living. But there is no standard school book on roasting, boiling, stewing, frying, making soups, and cooking vegetables. Mrs. Beeton or Miss Acton could have produced such a manual, if any of the book-publishing religious societies had asked for such a necessity. As to sewing, the art will be found more cultivated in the higher than in the lower middle classes. A widow lady, who had been well trained at home and abroad as a governess, and in that capacity had acted in several noble families, on the death of her husband opened a day school in a district of rich London shopkeepers. One day she received a visit from a very grand lady, the mother of a pupil, and the wife of a thriving shopkeeper. She came to protest against her daughter being taught the art of plain sewing and cutting out body linen. "We are well satisfied," she said, "with Maria Jane's progress in music and other accomplishments, but we keep four servants, and my daughters need never do plain work." The school-mistress at first employed the ordinary common-sense arguments without effect. She added, "When I lived in the family of the Duchess of Blank, my four pupils, the Ladies, &c., were all taught to cut out and sew the garments they presented to the poor. It is my system—I cannot alter it." The name of the Duchess acted like a spell, and the purse-proud dame submitted. Such are the peculiarities of a large class in rich England. It is from the influence of the intelligent women who have been returned to the School Boards, that we anticipate a better system, better teachers, and more useful books in our elementary schools. The example will speedily spread to our many ill-managed school charities, the worst managed being those for girls.

Preservation of Iron from Oxidization.

Among the many processes and preparations for preserving iron from the action of the atmosphere, the following will be found the most efficient in all cases where galvanization is impracticable; and, being unaffected by sea water, it is especially applicable to the bottoms of iron ships, and marine work generally: Sulphur, 17 lbs.; caustic potash (lye of 35° B.), 5 lbs., and copper filings, 1 lb. To be heated until the copper and sulphur dissolve. Heat, in another vessel, tallow, 750 lbs., and turpentine, 150 lbs., until the tallow is liquified. The compositions are to be mixed and stirred together while hot, and may be laid on, as paint, to the iron.

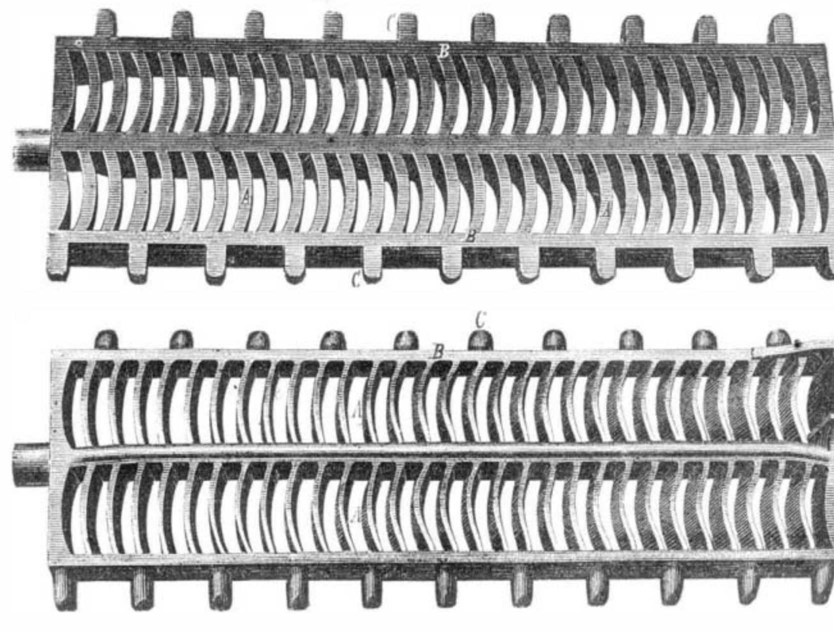
MARINE GLUE.—Mix together, gum sandaric, ¼ lb.; gum mastic, ¼ lb., and methylated spirit, 8 lbs. When the gums are dissolved, add ½ lb. turpentine, and mix this with a thick hot solution of the best glue (to which a little isinglass has been added to clarify it), and filter through muslin. The marine glue will be impervious to moisture, and will not soften in any ordinarily hot weather.

HOW TO CHOOSE A PUPPY.—Montaigne says: "Sportsmen assure us that, in order to make choice of a puppy from among a number of others, it is better to leave the choice to the mother herself. In carrying them back to their bed, the first one she takes up will always be the best; if we pretend to set fire to the bed on all sides, then the one she will try to rescue first." We would suggest in regard to the latter paragraph, that whoever may test the accuracy of the sportsman's receipt, be careful to not set the bed-clothes on fire in trying the experiment.

THE extravagant tendencies of the present generation suggest to a clergyman the inquiry whether it would not be better to devote half of one's energies to learning to live on a very small income, than to devote all of one's energies in struggling and waiting for a large income?

Improved Grate Bar.

Engineers have become thoroughly alive to the fact that the heating surface of boilers can never work up to its full efficiency without not only the proper amount of grate surface, but also such a construction of the grate that the fuel may be economically consumed. The combustion must not be partial, distilling off the fuel and sending it out of the mouth of the chimney in black volumes of smoke; it must be as complete as possible. Large heating surface avails nothing if the combustion of the fuel be imperfect, and the completeness of combustion depends primarily upon the grate, which must be of such a form that a full draft may be secured, yet be able to retain its form under the effects of heat, and support the fuel properly for the uniform distribution of air to the combustibles used.



GREENLEAF'S IMPROVED GRATE BAR.

A large number of patents have been issued for improvements in grate bars, and still inventions in this field increase and multiply. The demand for grate bars is so large that any bar which can fairly compete with those that have preceded it, is sure of sale, and the manufacture of such bars has grown into a large industry.

Our engravings show the form and construction of a grate bar, for which it is claimed that it effects a large saving in fuel, that it does not warp or twist, that it lasts much longer than the ordinary bar, and that it can be used in any furnace without the trouble and expense of making alterations.

The shape of the grate bar is such that a very large aggregate opening for the passage of air to the fuel is secured, resulting in more perfect combustion and greater rapidity in raising steam than is the case with many forms of grate bar in use.

Nut coal, slack, sawdust, shavings, and tan bark, can be successfully burned upon it, as is attested by those who have used it in the consumption of the combustibles named.

The bar is constructed with horizontally curved cross pieces, A, which act as braces, and in combination with the side plates, B, prevent warping or twisting, under great and unequal exposure to heat.

The grate, formed by the curved arch cross pieces, has a flat, even surface upon the top, so desirable in grate bars, and enables the weight of metal to be reduced, without increased liability of breakage from unequal expansion. The pieces also act as shears in cutting clinkers. It is claimed that actual use has shown that these bars will outlast two or three sets of ordinary bars. The bars, it is claimed, weigh less, per square foot surface measurement, than any other grate bar now in use, and the pieces are so constructed that they may be placed in any furnace without change in the bearing bars.

The exterior projections, C, on the side plates, B, form a series of apertures between the bars, when the latter are placed together in the grate, preventing the formation of blank spaces.

The under edges of the curved cross pieces are cast with a re-entrant curve, as shown in Fig. 2, which reduces their width, so that they do not readily clog up; and the ashes can readily be removed from the interspaces.

We have been shown testimonials in regard to this grate bar, which state that by its use a large saving in fuel has been secured, and also corroborating the claims made in regard to its durability.

Patented, Nov. 16, 1869, by Clements A. Greenleaf. For further particulars, address Greenleaf Machine Company, 319 South Tennessee st., Indianapolis, Ind.

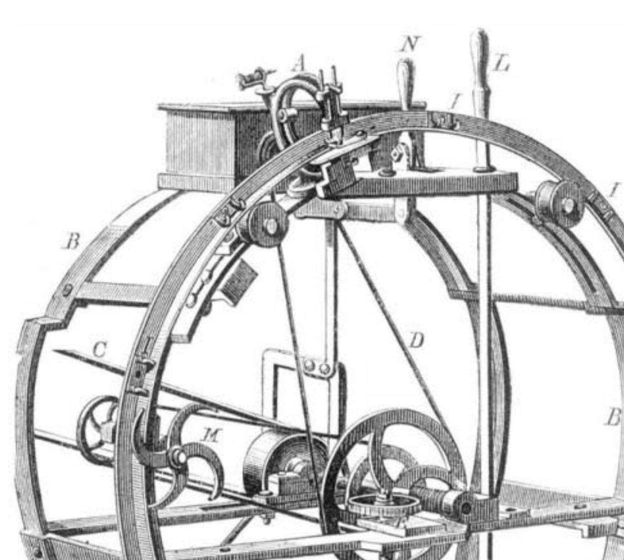
New Composing Machine.

The New York *Tribune* gives an account of a new composing machine, designed to supersede the use of fonts of type in printing. It says; The great feature of the invention is a mechanical device by which ordinary type setting and type distributing are dispensed with, and one hundred types are made to perform the service of a full font set in the usual way. The letters of the alphabet, together with figures, punctuation marks, and combination words, are arranged in regular order in a type-head two inches square, and are operated upon by keys, manipulated as in a piano. When the keys are touched, the type-head moves to its position, and action is had upon whatever letter or figure is touched, the type moving downward a prescribed distance, and making a printed impression on transfer paper. The platen on which the paper is laid is moved backward and forward by a feed-wheel for each impression of the type, and the spaces between the lines are produced by lateral motion by means of a ratchet wheel. In this way one hundred impressions are made per minute, and proofs can be corrected very easily. The impressions are finally transferred to a zinc plate, and printed by an improved lithographic press at the rate of 2,500 impressions per hour. In place of transfer paper a mold of clay or wax may be used to receive indentations, from which a stereotype cast can be obtained of uniform thickness, and ready for the press. The machine is driven with a treadle like a sewing machine, and occupies about the same space. It can be manufactured for $200, and the type-heads for $3 each. Every style of type borders, ornamentation, and also music, can be produced, only requiring one type to represent each character. The type-heads are easily changed, and as many as fifty styles can be employed by the compositor without rising from his seat. As originally patented, the types were arranged on the periphery of a disk or wheel, and the impressions, made upon prepared pulp or clay were justified with difficulty. By the improved machine, impressions are made upon paper, and justification and correction are accomplished without loss of time.

WE are glad to hear that the efforts to supply Nebraska with salt have been successfnl, and that saline water has been brought to the surface by an artesian well. A party of enterprising men in Lincoln city struck, at a depth of 600 feet, a stratum of sandstone, from which a torrent of salt water came upwards, and shot over eight feet into the air. When the well is tubed, a constant flow may be expected. The value of this discovery will be great, and a proper reward for Dr. Evans' untiring labors in the search. The strength of the saline water is estimated at 80 degrees.

IMPROVED SEWING MACHINE.

The invention which forms the subject of the present article is designed to provide a means for sewing goods together



in a continuous operation, as required in cotton mills, hosiery and bag manufactories, printing mills, and other similar works.

The stitching part of the machine may be of any approved kind of sewing machine now used, and is placed at A, as shown in the accompanying engraving, where it is sustained by the frame, B. The frame, B, also supports a central shaft with pulleys, as shown, which receives motion through the main driving belt, C.

The belt, D, conveys motion from the central shaft to the stitching part of the apparatus, A. Upon the central shaft is cut a screw thread which actuates the worm gear, E, and through it the vertical shaft, F. Upon the lower end of the vertical shaft, F, there is keyed a toothed wheel, G, which meshes into teeth (not shown in the engraving) on the back of the flanged feed-ring, H. This ring is suspended on flanged friction wheels, K, which sustain it vertically and laterally, but leave it free to rotate in the proper direction when actuated by the wheel, G.

At intervals around the flange of the feed ring, H, are placed hooks, I, upon which the edges of the cloth to be sewn are stretched, and are fed to the sewing attachment as the ring revolves in the manner described.

A sliding plate, J, which sustains the lower bearing of the vertical shaft, F, is moved back or forward by the hand lever, L, which throws the toothed wheel in or out of gear with the feed ring, as desired by the operator.

The friction rollers and all the moving parts below the central shaft are covered by a flat plate or shield, not shewn in the engraving, as when in place it conceals the working parts. To prevent the cloth from being carried under this shield, four bent arms, M, are attached to a short pulley shaft driven by a belt from the central shaft. These arms press the cloth off from the hooks on the feed ring, and thus released, it falls down upon the floor which supports the machine.

The hand lever, N, runs the stitching part of the machine into or out of gear, as may be desired.

We are informed by the inventor that this machine has stitched one thousand pieces of cloth, 28 inches wide, per day, with one hand, and it has stitched, in one day, forty-five pieces (of same width) more, with one operator, than was done by two operators with the Willcox & Gibbs sewing machine without the attachment.

Patented through the Scientific American Patent Agency, Nov. 1, 1870. For further information address W. A. Rayer or W. S. Lincoln, patentees, care Willcox & Gibbs, sewing machine manufacturers, 147 Tremont st., Boston, Mass.

A 30-Inch Gage Railroad in Ohio.

The Toledo *Commercial* having stated that the Piqua, St. Mary's and Celina Railroad Company had been incorporated on a capital basis of $400,000, to build between Piqua and Celina, through Miami, Shelby, Auglaize and Mercer counties, Ohio, about forty-four miles, a Piqua correspondent gives us the details of the scheme.

The country along the line is very populous and productive, and the question of an outlet by railway has long been agitated. But the Miami and Erie canal passes through it already; and though inadequate to the wants of the country, there is scarcely warrant for the construction of an expensive road. Last winter, the plan of a narrow-gage road, to cost, fully equipped, less than half a million of dollars, in place of one of the ordinary gage, costing a million and a half, was discussed. The design is identical with that of the Welsh railways, which have been so often described in engineering journals of late. A road of this kind, for trans- porting coal—the only one in this country as yet—is already in operation between Akron and Massillon, Ohio. A system of narrow-gage railways is also projeted from Toronto, Canada, as feeders to the wide-gage roads now centering there. We learn that parties interested in the proposed Buffalo and Springfield road are now examining the Canada system, with a view to the adoption of the narrow gage. The Kansas and Denver Pacific Companies also contemplate reaching the mining regions near Denver, and probably at no distant day penetrating the Great Mountain Parks, and perhaps passing over the entire range, by narrow-gage roads, costing only one seventh as much as the present gage, where the latter is practicable. In all these cases the data, showing the entire practicability of these roads, and giving the cost of construction and operation, are such as to reduce the prospects of any such enterprise to a certainty.

To return to the Ohio road. The right of way is to be fifteen feet in place of forty feet; twenty pounds instead of fifty-six pounds iron will be required; the locomotives, weighing six tuns instead of thirty, will draw from ten to twenty loaded freight cars, each having a capacity of two and a half tuns; under freight and passenger cars alike (the latter seating twenty persons) four-wheel trucks will be placed; the ties will, of course, be nearer than on the wide gage; while finally, on account of the lightness of car equipment, in comparison with capacity, and of the central position of the trucks, both higher gradients and sharper curves will be practicable, greatly reducing cost of excavation, and other important items of construction.

In the present instance, the route presents no engineering difficulties—Piqua, thence following the canal to Berlin; thence to Minster, Bremen, and St. Mary's, where it will leave the canal, and make Celina its northern terminus.

The enterprise, which is to be begun in January, is in the hands of able and energetic citizens—among the corporators being Hon. J. F. McKinney, member of Congress elect; William Scott, one of the oldest citizens, and President of the Piqua National Bank; J. G. Young, Cashier of the same; Henry Flesh, a wealthy merchant of the city; Chas. C. Clute an experienced railroad builder, of New York city.—*Chicago Railway Review.*

Additions to Clubs.

For the information of subscribers the publishers of the SCIENTIFIC AMERICAN give notice that they will receive additional names at any time, to clubs already formed, at club rates.