IMPROVED SLATE IRON FOR CARRIAGE TOPS.

In covering the exposed portion of the bows of a top carriage it is necessary with the slat irons in common use to attach a mitt or cap at the bottom. This is only a manner of concealing an imperfectly finished job, which when the work is done by hand is usually avoided by good workmen. Carriage work, however, is now largely done by machinery, the leather stitching especially, and while straight work done on the machine is neater than the usual hand work it is not relied upon for such jobs as covering bow irons.

The engraving shows an improved bow iron which allows the slat or bow to be removed to receive its cover. In the engraving the two outside slats are covered. A represents one showing the side to which the iron is attached. B is partly in section, showing the screw by which the slat is attached to the pivoted end of the iron. The bows being fitted for the trimmer, he takes them, cuts out the covering, bastes it on the bow, then slips it off and runs it through the sewing machine.

It is then drawn back on the bow and the bow screwed on the jointed part. The job when finished is perfect and has a very neat appearance, considered superior to that of those covered in the ordinary way. Every carriage maker or trimmer will easily understand the advantages of this method of covering. It was patented through the Scientific American Patent Agency, Oct. 30, 1866, and is said to give excellent satisfaction in use. Address for further information A. M. Decker, Glenn's Falls, N. Y.

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The Employment of Acid in the Making of Sugar.

During the last three years acids have been largely employed in the manufacture of beet-root sugar in France, and within two years several sugar houses have been specially arranged for the acid process. M. Kessler Desvignes has recently communicated to the Paris Academy of Sciences the results of this new method. The defecating action of sulphuric acid on beet-root juice is well known. When acid of 66° is added to juice of ordinary density, an abundant precipitate is thrown down, and is continued by subsequent additions of acid until it reaches to 2½ millionth parts of the whole weight of the juice. Most of the acids produce the same effect in different doses, but the separation of the deposit is more or less complete in proportion to the energy of the acid. When heat is applied, the precipitate rises to the surface, and is easily got rid of by skimming. Such was the mode originally adopted when sugar was first made in France, but it had to be given up because the defecation was not complete, and also because it injured the crystallization of the sugar. M. Desvignes imagined, however, that it might be advantageously reintroduced with modifications, and having achieved considerable success, he thus explains his process:—1st. Acids employed at the ordinary temperature, even in large doses, do not affect the sugar, and therefore it is only necessary that they should be saturated by a base before heat is applied. 2nd. On the other hand, acids arrest viscous fermentation, and doubtless the effects of other ferments also; they act as powerful antiseptics, and thus prevent the formation of the glareous substance which seems to be one of the gravest causes of bad sugar making, and, on the other hand, they prevent the destruction of the sugar by the ferments with which it is brought into contact when the cells of the beet root have been broken by rasping; and this destruction, M. Desvignes believes, is far more rapid and more considerable than is generally believed. The antiseptic effect may be easily exhibited by taking pure juice and mixing it with other juice which has become glareous to the extent of 5 per cent, then separating it into two parts, and treating one of these with from 2½ to 3 thousandth parts of its weight of sulphuric acid at 66°. On the following day it will be found that the juice which has not been acidified will have become cloudy and viscous, while the other will remain clear, with the deposit caused by defecation at the bottom. M. Desvignes gives the details of his experiments with non-acidified glareous juice, proving the loss in sugar caused by the viscous change, and draws the conclusion that, contrary to generally accepted opinions, acids, instead of having an injurious effect on sugar in cold juice, preserve it, on the contrary, from the destructive effects of fermentation. The same experiments applied to beet-root juice kept for a longer time exhibit the same effects to a still more remarkable extent. 3rd. It is easy to prevent all danger or inconvenience by choice of acids; fluorhydric, hydrofluosilicic, and phosphoric acids, as well as many of their combinations—such as the fluosilicate of magnesia, which is easily obtained in a crystallized form—the fluosilicates of alumina and manganese, the biphosphates of lime, magnesia, or alumina; the phosphate of lime dissolved, or attacked by fluorhydric acid, hydrofluosilicic, hydrochloric, or nitric acid, never produce callosity, and may be used without the slightest ill effect, either as regards the workmen or the pulp. 4th. Defecation by acids is easily completed by the precipitation of certain substances more or less basal, such as magnesia, the silicates and aluminates of lime, the compounds of starchy matter with that base, the insoluble phosphates, the fluoride of magnesium, calcium, and aluminum, etc., and the above named acids easily bring about such deposition. It is only necessary to saturate them with lime, or to dissolve previously in the acidulated juice some of the bases which it is desired to precipitate. Thus a kind of analysis on a large scale is carried on in the manufacture, separating, in the first place, the insoluble organic acids by means of those which are added; and afterwards, the soluble acids with the neutral or basal compounds liable to form with the lime and magnesia compounds difficult of solution. One of the advantages claimed for the system in question is that of effecting very complete defecation with an excess of lime, so that the juice may be immediately evaporated and boiled without the necessity of using charcoal. Thus, we find in acids powerful antiseptics, possessing this advantage over lime—that they may be added to the pulp without danger to cattle, preserving the sugar against fermentation, and yielding in one operation, instead of two, perfectly defecated juice, which, by the addition of a simple solution of lime, yields as much crystallizable sugar as if it had been passed through charcoal.—*The Grocer.*

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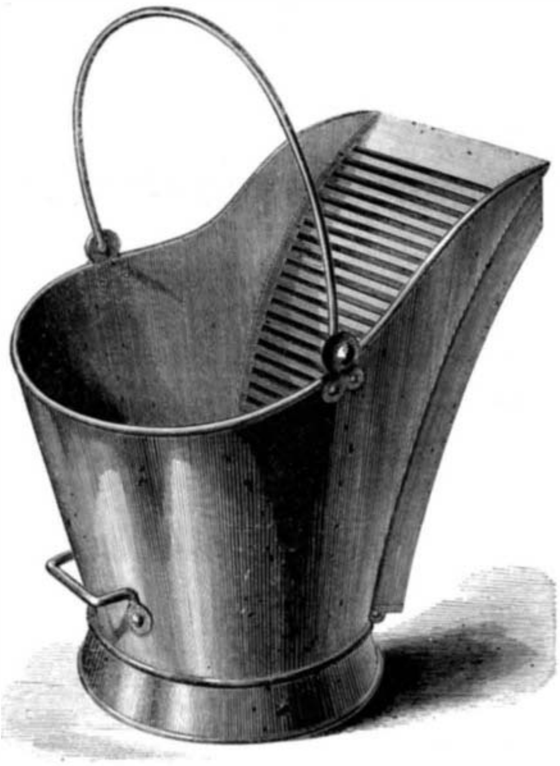
COMBINED COAL HOD AND ASH SIFTER.

Nothing can be neater or handier than the improved coal hod herewith illustrated. It is at once a receptacle for the fuel and ashes and a sifter of both. Its construction shows an eye to proportions as well as an object of utility. The hod is in the usual form, the discharging surface being perforated either with transverse slits arranged diagonally to retard the escape of the debris as may be desired. In front is a channel formed of a bent sheet of iron and having at the bottom a hinged door to let out the ashes or dust. It shows for itself that it has great advantages over the ordinary hod and will recommend itself to all housewives. Its cost of construction cannot be much greater than that of the ordinary hod, while its advantages must be obvious.



This hod is the subject of a patent issued in favor of Yateman and Mason, Washington, D. C., Jan. 15, 1867. For further particulars address Alexander & Mason, cor. 7th and F streets, Washington, D. C.

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Philadelphia Butter.

The editor of the *Practical Farmer* has been investigating the source of the excellence of this celebrated product. He finds that with the model dairyman butter-making is a matter of business, and all the minutiæ receive his personal attention. The quality appears to depend on a number of very important though minute processes. Butter made from sweet cream will not keep well, and until the milk sours all the cream cannot be obtained, while if left longer rancidity ensues. A small quantity of sour milk is therefore put into each pan to hasten this process, unless the weather is such that the souring of the milk takes place within the thirty-six hours which are considered the proper time for the milk to stand before being skimmed. The skimming must be done exactly at the right time. The temperature, 62°, is regulated by a thermometer. The cream vessels are kept in water at a low temperature, and regularly twice a day are stirred thoroughly with a wooden spatula. At churning time these cream pots are plunged into a boiler of hot water, and stirred rapidly with a stick, till the temperature reaches 60°, when they are immediately emptied into the churn. When the butter begins to break a quantity of cold water is poured in, which tends to harden it and cause a more thorough separation of the buttermilk. This is then drawn off and more water thrown in, to wash out any still remaining. After working and seasoning, the butter is laid in water on a clean cloth for a couple of hours, when it is worked over again and finally prepared for market.

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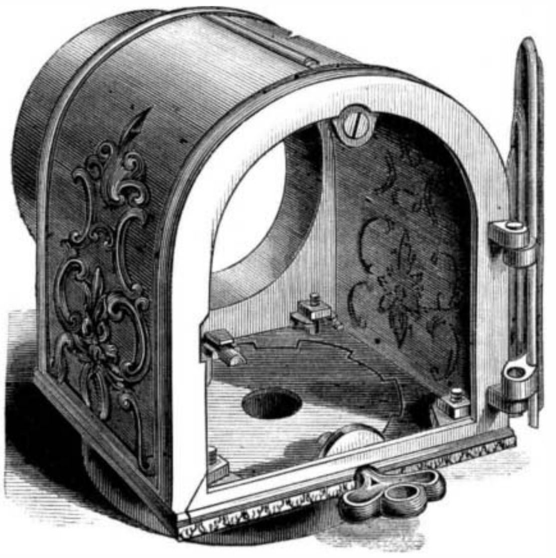
WILSON'S COMBINED FUNNEL ELBOW AND DAMPER.

In some parts of the country bituminous coal is largely used for cooking as well as for heating purposes. Much of the volatile constituents of this fuel is unconsumed, and being delayed in its escape to the outer air, is deposited in the funnel of the stove. With the ordinary stove-pipe no other remedy is possible except to take down the pipe at not unfrequent intervals and clean it. The lodgement of these particles of unconsumed carbon is generally in the horizontal portions of the pipe, especially where the upright joins. The device shown in the engraving is an ornamental elbow, easily accessible, by opening which the debris may be drawn or swept out.



The bottom and ends are of cast-iron, and the cover or upper part may be of the same substance or of sheet-iron as preferred. A flange at the bottom receives the vertical pipe, and a similar flange at one end of the contrivance, the horizontal length. Opposite this latter opening is a door, represented open in the engraving, by which the interior may be reached. A damper, either rotating, as shown in the engraving, or a slide, forms the bottom of the elbow. In either case it has an aperture sufficiently large when the damper is closed to allow the escape of deleterious gases into the chimney. The damper, which forms a plate or floor for the reception of the deposit is also useful as a damper, as by it the combustion of the fuel can be easily regulated and controlled.

These elbows are made of all sizes—fitted to all ordinary pipes—and are but slightly more costly than the ordinary funnel elbow. In addition this is ornamental as well as useful, and does away with the annoyance of new elbows where a change of residence becomes necessary. It can be hinged at the turn of the pipe to aid in the adjustment of the funnel, and is made in this style so as to suit all circumstances. Wilson and Wood, Wilmington, Del., are the proprietors of the patent, which was granted through the Scientific American Patent Agency, Dec. 11, 1866, and to them all communications should be addressed.

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THE CANNON KING.

[Translated for the Scientific American from the Leipsic *Gartenlaube.*]

Just after the war between the two great German powers was over, the European as well as American journals entertained their readers with descriptions of the inventor of the Prussian needle gun and of the arm itself, and it seems only justice to give our readers a description of the immense manufactory of that man whose genius gave the Prussian artillery an arm of no less importance than that of the infantry. Mr. Alfred Krupp's far-famed establishment is in an exceedingly favorable situation, at the junction of three grand railways of western Germany, about two hours from Cologne, in the direction of Berlin. Here in Essen, Krupp inherited, as a boy of fourteen, a small workshop for manufacturing cutting engines. By ability, energy and good luck he enlarged his workshop gradually, so that in 1865 he manufactured, by the aid of 160 steam engines, 39 steam hammers, and 400 melting, glow and cement furnaces, no less than 1,000,000 cwt. of cast steel, one third for cannon and the rest in large bars for steam engines, axles, wheels, boilers, etc., etc.

Krupp's first steel cannon were cast in 1849 and offered to the chief German governments, but refused by them because they thought the article too novel and costly. The Viceroy of Egypt was the first who ordered them. (Our readers will remember that Mr. Dreyse's offer of his needle gun was also refused at first for a similar reason.) Since that time nearly all the great powers of the civilized world have ordered Krupp's cannon. Russia is going to alter her cannon to steel in her manufactory at Alexandroffsky, expressly erected for this purpose. Prussia buys steel cannon, which are cast at Essen and rifled at the fortress of Spandau: she has, however, her own system of breech loading, which is different from Mr. Krupp's. Belgium and some smaller states have accepted Krupp's system, or still partly use the Prussian arm. The Austrian and Dutch navies are partly supplied with steel cannon. The Italians have bought some six-inch breech-loading guns. Krupp's best customers, however, until lately, were the Turks, who have bought no less than 200 six-pounders, and the Japanese, who, on their trip through Europe two years ago, ordered at once 60 six-inch cannon, 30 of which were delivered in September last. Mr. Krupp's establishment has delivered 2,500 cannon of steel, mostly rifled breech loaders, 400 of which have a caliber of eight inches and more, the rest having from three to four and a half inches.

The workshops of Krupp cover at present ever 500 acres of land, consume daily 15,000 cwt. of coal, work by steam from 120 boilers, are illuminated by 7,000 gas lights, and employ over 8,000 men and boys, whose wages amount to about 2,500,000 dollars, or an average of 312½ dollars each per annum. A fund has been established to which every workman has to contribute an average of one groschen (about three cents) of every dollar he earns, in return for which he receives support in case of sickness, and a good pension in his age. Mr. Krupp himself contributes to this fund half as much as his workmen: so that in fact, if a workman pays for instance $1, the fund gets $1·50. From this source every workman gets, after twenty-five years service, a good pension. In case of accident, he receives full wages during the whole time of inability to work, and if sick he is supplied with medicines, and finally, burial expenses are usually paid out of this fund. Besides this, Mr. Krupp's workmen enjoy a good many other advantages. To supply them constantly with good and cheap bread, he erected bakeries in a grand style, the flour for which he buys in large quantities from Russia. Similar arrangements have been made to supply them with good and cheap potatoes, and we hear that Mr. Krupp intends to do the same with meat. These father-like arrangements prove very beneficent for both employer and workman, and have been imitated in England in many of the large manufactories.

The iron ores for the enormous demand are partly from Krupp's own mines in the late dukedom of Nassau, and near Coblentz, and are partly bought. The former give the well-known Spiegel iron. It contains a large quantity of manganese, of which, however, it is cleaned by a simple process, and contains then over 98 per cent of pure iron, the other two per cent consisting mostly of silicious earth, cobalt, nickel, copper, and a very small quantity of phosphorus. That which is to be used for cannon must be softer than ordinary steel, so as to have a certain elasticity under the force of the discharge. This softness is attained by mixing a quantity of forge iron in the steel mass. Iron and steel are cut into bars of six inches length and put in plumbago crucibles containing from thirty to sixty pounds each. The manufacture of these Krupp crucibles was a secret for a long time. At present, however, those of Ruel in London, and the Patent Crucible Company, Battersea, are deemed to be almost as good. The foundery is an enormous building, containing so many furnaces that the necessary iron and steel masses for castings of the largest dimensions can be melted there in 1,200 crucibles at the same time. About ten crucibles are placed in every furnace, resting on movable bars. The heat in the furnaces is so great that the best Scotch fire-proof stones which surround them, and sometimes even the crucibles, melt, so that the latter can be used but once. The workmen are divided into companies, and obey commands with the greatest precision, so as to be able to found the contents of the different crucibles all at once into a reservoir and thence into the mold beneath. As soon as the casting is solid it is surrounded by hot ashes and kept in a red glow until the forging takes place. As this can only be done in cool weather, the largest pieces sometimes lie two or three months in their hot beds, the necessary temperature being maintained by constant supplies of glowing ashes.

The castings consist first of round or square forms, and are afterwards forged, hammered or turned. By the regular form of the casting, a symmetrical mass is obtained, free of bubbles; the steam hammer gives the mass the necessary compactness, strength and elasticity, and generally compresses it 2 or 3 per cent, and the power of resistance rises from 760 to 1,320 cwt. per square inch. The last mass for the cannon is pretty soft and has a power of resistance from 800 to 900 cwt.

The smaller cannon consist of one solid piece: those over eight inches caliber are compound, and fastened by rings. The largest *steel* cannon yet manufactured is of eleven inches caliber. It was first cast as a cylinder of 750 hundred weight and seven feet diameter, and then forged, after which it was strengthened by rings of cast steel. Two monsters of this kind, weighing 540 cwt. each, and worth about 14,000 thalers, have been manufactured for the Russian government They are breech-loaders, and are able to throw a ball of 540 pounds with a charge of 50 pounds of gunpowder. Their destination is the Russian fortress of Kronstadt. A still larger monster of 15-inch caliber, throwing balls of 900 lbs., for the same government, will be at the grand exhibition.

The steam hammers are of great importance in Krupp's establishment. The largest of this kind has a fall of ten feet and cost about 700,000 dollars, two thirds of which were paid for the tilter or bed of the hammer, which has not sunk in the least, although the hammer has been thundering day and night. We should say that nothing could resist the power of these blows, but the large masses of red glowing steel it has often to forge bear these blows with so much resistance that they become effective only by long repeating. Mr. Krupp has therefore decided to use a three times greater power upon his steel, and to forge a hammer of 2,400 cwt. with a fall of thirteen feet. The cost thereof will be about 1,300,000 dollars.

Steel cannon were until lately the principal manufactures of Krupp, but lately he has also manufactured a good many balls and bombs for the Russian government, to which he has delivered several thousands of oblong eight and nine inch shot and shell, all the finest cast steel, the smaller sort of which contain eight pounds of powder and are able to crush iron plates five and a half inches thick. But every one of these pills costs over 100 dollars, all being hammered and forged. Similar though smaller bombs are destined for the Italians, and partly already delivered.

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THE MECHANICAL EQUIVALENT OF HEAT.

Prepared for the Scientific American.

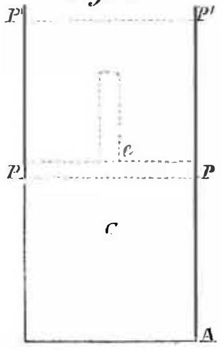
Our present mechanical equivalent of heat is established by proofs of such seeming strength and conclusiveness that it is no light matter to call its truth in question; however, I propose to show that these proofs are not really so conclusive as they appear and that our equivalent, which says a unit of heat will give 772 foot lbs. of force, has no direct proof for its support but the all direct proof which can at the present time be brought to bear on the subject would go to establish quite a different measure for the power of heat. I will first quote from "Heat considered as a mode of motion," by Professor Tyndall, to show how the equivalent has been established and will then present the reasons for making the above statement.

"Using the accurate numbers, the quantity of heat applied when the volume is constant, is to the quantity applied when the pressure is constant, in the proportion of 1 to 1·421.

"This extremely important fact constitutes the basis from which the mechanical equivalent of heat was first calculated. And here we have reached a point which is worthy of, and which will demand, your entire attention. I will endeavor to make this calculation before you.

"Let C, (in Fig. 1,) be a cylindrical vessel with a base one square foot in area. Let P,P, mark the upper surface of a cubic foot of air at a temperature of 32° Fah. The hight A P will then be one foot. Let the air be heated till this volume is doubled; to effect this it must, as before explained be raised 490° Fah. in temperature; and, when expanded, its upper surface will stand at P′ P′, one foot above its initial position. But in rising from P P to P′ P′ it has forced back the atmosphere, which exerts a pressure of 15 lbs. on every square inch of its upper surface, in other words, it has lifted a weight of 144×15=2,160 lbs. to a hight of one foot.

Fig. 1



The "capacity" for heat of the air thus expanding is 0·24 water being unity. The weight of our cubic foot of air is 1·29 ounces, hence the quantity of heat required to raise 1·29 ounces of air 490° Fah., would raise a little less than one-fourth of that weight of water 490° The exact quantity of water equivalent to our 1·29 oz. of air is 1·29×0·24=0·31 oz.

"But 0·31 oz. of water, heated to 490° is equal to 152 oz., or 9½ lbs. heated 1° Thus the heat imparted to our cubic foot of air, in order to double its volume and enable it to lift a weight of 2,160 lbs., one foot high, would be competent to raise 9½ lbs. of water 1° in temperature.

"The air has here been heated under a constant pressure, and we have learned, that the quantity of heat necessary to raise the temperature of a gas under constant pressure a certain number of degrees, is to that required to raise the gas to the same temperature when its volume is kept constant, in the proportion of 1·42 : 1 hence we have the statement—

$$1{\cdot}42 : 1 = \overset{\text{Lbs.}}{9{\cdot}5} ; \overset{\text{Lbs.}}{6{\cdot}7}$$

which shows that the quantity of heat necessary to augment the temperature of our cubic foot of air, at constant volume, 490°, would heat 6·7 lbs. of water 1°.

"Deducting 6·7 lbs. from 9·5 lbs., we find that the excess of heat imparted to the air in the case where it is permitted to expand, is competent to raise 2·8 lbs. of water 1° in temperature.

"As explained already, this excess is employed to lift the weight of 2,160 lbs. one foot high. Dividing 2,160 by 2·8, we find that a quantity of heat sufficient to raise one pound of water 1° Fah. in temperature, is competent to raise a weight of 771·4 lbs. a foot high.

"This method of calculating the mechanical equivalent of heat was followed by Dr. Mayer, a physician in Heilbron, Germany, in the spring of 1842.

"In August 21, 1843, Mr. Joule communicated a paper to the British Association, then meeting at Cork and in the third part of this paper he describes a series of experiments on magneto-electricity, executed with a view to determine the "mechanical value of heat." The results of this elaborate investigation gave the following weights raised one foot high, as equivalent to the warming of 1 lb. of water 1° Fah.

1.	896 lbs.	5.	1026 lbs.
2.	1001 lbs.	6.	587 lbs.
3.	1040 lbs.	7.	742 lbs.
4.	910 lbs.	8.	860 lbs.

"In 1844 Mr. Joule deduced from experiments on the condensation of air the following equivalents to 1 lb. of water heated 1° Fah.

823 foot lbs.
795 foot lbs.
820 foot lbs.
814 foot lbs.
760 foot lbs.

"As the experience of the experimenter increased, we find that the coincidence of his results become closer. In 1845, Mr. Joule deduced from experiments with water, agitated by a paddle wheel, an equivalent of

890 foot lbs.

"Running up his results in 1845, and taking the mean, he found the equivalent to be

817 foot lbs.

"In 1847, he found the mean of two experiments to give as an equivalent

781·8 foot lbs.

"Finally, in 1849 applying all the precautions suggested by seven years experience, he obtained the following numbers for the mechanical equivalent of heat:—

772·692, from friction of water, mean of 40 experiments
774·083, from friction of mercury, mean of 50 experiments
774·987, from friction of cast-iron, mean of 20 experiments

For reasons assigned in his paper, Mr. Joule fixes the exact equivalent of heat at 772 foot lbs.

"According to the method pursued by Mayer, in 1842, the mechanical equivalent of heat is

771·4 foot lbs.

"Such a coincidence relieves the mind of every shade of uncertainty, regarding the correctness of our present mechanical equivalent of heat."

This subject will be completed in another article.

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CURIOSITIES OF COMBUSTION.

BY PROFESSOR CHARLES A. SEELY.

"Combustion is the disengagement of heat and light which accompanies chemical combination." This is a very good definition, the best one I remember to have seen. I intend this as a high compliment for I have observed that school-book definitions often need more explanation than the thing defined. It is a very interesting and profitable mental exercise, to discover the heterogeneous things that a definition owing to its inaccuracy of language, is obliged to cover. Any book on the physical sciences will furnish good material. It is a very ancient amusement. Plato once defined man to be a "two-legged animal without feathers," a definition of man about as precise as ever was made. But Diogenes plucked a goose, and throwing it into the Academy, exclaimed, "Plato, behold your man." So I might bring phosphorus and rotten wood which shine in the dark and to a delicate thermometer exhibit heat, as cases of combustion. But Dr. Ure, the author of the definition, might very aptly retort, as did the preacher whose sermon was criticised, "better it if you can." And I should be forced to reply, "I cannot unless you allow me to use a great many more words."

The combustion with which we are most familiar is that where oxygen is one of the elements concerned. A very interesting peculiarity of this ordinary combustion is the fact that its beginning requires a high temperature. We consider coal, wood, oil, sulphur, and gunpowder very combustible, but there is no combustion, although oxygen be present, until they be set on fire or ignited, that is, until some portion be heated up to a high temperature. Oxygen is very different from other supporters of combustion in this respect, for with them combustion begins at ordinary temperatures. If suddenly chlorine were put in the air in place of oxygen, or if the oxygen should assume its active form known as ozone, every thing combustible upon the earth would take fire and be consumed with fervent heat in a few hours. This property of oxygen, to which I allude, is another of the striking evidences of the adorable Wisdom everywhere to be found in the order of nature.

The temperature of ignition varies greatly for the different combustibles. Phosphorus, sulphur, and sodium take fire below a red heat, while the ignition point with others is so high that we rarely have an opportunity to see them burn. The combustible nature of iron, lead, copper, silver, and gold, was not even suspected until a recent period. We know now that they burn even more readily and fiercely than any common fire, when once they are kindled; if I wanted to make the most gorgeous pyrotechnic display I would make a bonfire in which I would burn up a few tuns of iron. The ignition temperatures have been determined for only a few substances. Here is useful work to be commended to the rising generation of chemists. The facts ought to be determined and put into the form of a table.

The philosophy of spontaneous combustion is now well determined and can be made plain to everyone. Heat is always a product of oxidation, or in other words, heat always accompanies the union of oxygen with another substance. The amount of heat produced is, moreover, exactly proportioned to the amount of oxidation. If a day or a year be employed in burning (oxidizing) a pound of coal the amount of heat in the two cases is precisely the same. The rapidity of burning has nothing to do with quantity of heat; it is a question of intensity, quite another thing. The pound of coal burning in a minute gives an intense heat and consequently light, but let that heat be distributed over the space of a year, and it would require an instrument far more delicate than our senses to detect that which would appear in a second or a day. In slow burning or oxidation the heat is simply diluted in time or space. Let a child's supply of candy be divided and administered constantly, and in the homeopathic doses he would never suspect that candy had any taste.

The rust which is produced from a pound of iron indicates or represents an amount of heat sufficient to raise nearly 3,000 pounds of water 1° Fah; that is such a quantity of heat was produced by the rusting or oxidation. As the specific heat of iron is one-ninth (nearly) that of water, this quantity of heat is sufficient to raise the temperature of one pound of iron to the temperature of 27,000°, or nine pounds to 3,000° which last is without doubt above the ignition point of iron. Suppose the heat of rusting be retained in the rust. Would not we have a spontaneous combustion which would be fearful even to think of!

In ordinary oxidation the heat leaks away by radiation and conduction as fast as it is generated. Let us see how we may retain it. As oxidation takes place only at the surface it is plain that its rapidity will be increased just as we increase