SCIENTIFIC AND PRACTICAL.

SMOKE CONSUMPTION

The question of "smoke consumption" is an important one at the present time, hence we head this article with that title, but more properly the name is a misnomer, and what we are going to talk about should be entitled "Proper Combustion." In every district burning bituminous coal there is trouble with unconsumed carbon which is deposited in the form of soot, and is a great annoyance to everyone, to say nothing of the evident waste of fuel London, Cincinnati, Pittsbug, Wheeling, and other such towns, suffer much from the fouling of everything by the smoke or soot. But these are but manifest injuries. There is just as much loss in the way of unconsumed fuel passing off without being thoroughly and completely burned as there is from that which has not even commenced to burn; and this evil exists in all places where solid fuel is used, only this loss is not so evident nor so annoying Wherever combustion takes place for heating purposes there is loss from incomplete or improper combustion All the fuel that we use consists principally of carbon and hydrogen, which by their more or less thorough and complete combination with the oxygen of the air give off more or less heat, and less or more visible smoke. The surface of the gases of combination gives off light owing to the more perfect combination of the fuel at the surface with the oxygen of the air. The hydrogen of the fuel burns with a faint blue flame In 100 cubic feet of air there are about 79 cubic feet of nitrogen and 21 cubic feet of oxygen, with some water and a very little carbonic acid gas. These are simply mixed, not combined chemically These combined with carbon and hydrogen of the fuel form carbonic acid and carbonic oxide, and there is given off uncombined nitrogen, unconsumed air and steam One pound of carbon, if properly burned, will combine with 2 67 pounds of atmospheric oxygen to form 3 67 pounds of carbonic acid, and there would be 8.94 pounds of nitrogen left The nitrogen is also inert, and serves to prevent too rapid combustion of the fuel, and oxidation of the metal of the furnace, boiler, etc. If one pound of carbon be properly burned to carbonic acid it will give off 14,544 heat units, that is, enough heat to raise one pound of water 14,544 degrees F., or 14,544 pounds of water one degree F. The temperature of the complete combustion of one pound of carbon to carbonic acid is 4,880 degrees F. Each pound of hydrogen in the fuel takes eight pounds of oxygen to burn it completely, needing for the purpose thirty-six pounds of air, forming nine pounds of water and setting free twenty-eight pounds of nitrogen The complete combustion of one pound of carbon takes nearly twelve pounds of air. If one pound of carbon be incompletely oxidised or imperfectly burned, it will, instead of forming carbonic acid (CO_2) form carbonic oxide (CO). One pound of carbon will, in this case, combine with 1⅓ pounds of oxygen, which it will get from about six pounds of air If the combustion be very incomplete there will be unconsumed carbon carried over bodily with the escaping gases of combustion, and deposited in the form of soot. It is then necessary to admit enough air to thoroughly consume all the carbon; that is, to not only combine with all the carbon, but to thoroughly oxidise it to carbonic acid. There is nothing complicated or abstruse about this matter. If there be not enough air admitted to the fuel the combustion will not be complete, and there will be black smoke if there be any unconsumed carbon. But if the carbon has been at all oxidised the eye will not be able to distinguish whether or not the combustion has been perfect. It is then a mistake to suppose that because the eye can detect but little colour in the smoke which issues from the chimney there is no waste of fuel. We shall go over this question so that the same directions for avoiding soot or visible smoke shall, if obeyed, be sufficient to cause proper combustion of the carbon in the fuel, for it is the carbon that constitutes the greater and more valuable part of fuels, and gives the most trouble, especially of bituminous fuels. In order for combustion to be kept up, the burning bodies must have a temperature of not less than 800 degrees F We must not only have enough air to effect a complete combustion (twelve pounds of air per pound of coal as a maximum), but the air and the coal must be thoroughly mixed. There must be as much surface contact between the air and coal as possible This may be aided by letting in some air above the grate, care being taken to subdivide it as much as possible by admitting in the fine streams through tiny holes in the upper door, or in a special pipe. Although twelve pounds of air per pound of coal is enough in theory, yet in practice there must be much more, generally at least twenty-four pounds where there is nothing but an ordinary chimney to cause draft. The use of a fan or blower will enable proper combustion to be effected with eighteen pounds of air per pound of coal. There is one disadvantage in doubling or increasing in any degree the quantity of air admitted, that by doubling the air supply the temperature of combustion will be reduced one-half. Hence, although air is cheap and we may get proper and thorough combustion of the coal by admitting enough air to oxidise all carbonic oxide into carbonic acid, it is much better and more economical to let in as little air as possible in excess of the twelve pounds needed with a perfect furnace, and so admit this air as to cause complete oxidation There are some so called 'smoke consumers' that really do more harm than they do good, as they simply bring the smoke to a higher temperature, without giving it any more air Now, such devices have the effect of causing the combination of the soot that is in the smoke with the carbonic acid or completely burned carbon, bringing the whole volume of gases down to the condition of carbonic oxide By this means there may be an apparent "combustion of smoke," that is, a lessened deposit of soot, but there is an actual waste of fuel by other means; and for this reason they are not to be recommended. One of the most common causes of visible smoke, as well as incomplete combustion of the fuel, is too frequent and too heavy firing. This is directly in the province of the stoker to prevent If a fireman be careless or ignorant, or lazy, he will put on coal as seldom as possible, and when he does put any on there will be a sudden cooling down of the whole mass of coal on the grate; the new fuel will be partially distilled and the gases will fly up the chimney laden with soot There are some chimneys that tell instantly when coal is put on below, and they will show very plainly the skill or lack of skill of the fireman. A friend writing from Germany, in 1879, says: "We went to look at a smoke consuming device at a paper mill near Freiberg, in Saxony. We had a cold ride up the mountains in a sleigh. It was bitter cold; our visit was not announced, and when we got near to the paper mill, our hearts sank within us, for, not seeing any smoke from the chimney, we thought that the mill was shut down. But it was not. The stoking apparatus fed in the slack coal which was used as fuel by means of a continuous screw below the grate, and the combustion was so perfect and regular that there was no smoke to be seen coming from the chimney" Not only this but the combustion was so much more complete, and so well distributed in the passages, that about one-third of the fuel was saved over the former arrangement. In this case the fuel was fed in constantly by the screw upon a "coking plate," when the gases at once rose and were consumed; the coke moving backward and upward, and being finally consumed, and the ashes being removed at intervals from the back of the grate. It was just like the combustion of a candle; the solids are vaporised, and the coke, representing the wick, gradually consumed Such an arrangement applied to every furnace in Cincinnati would materially lessen the soot nuisance, and give more regular steaming or heating with less fuel and less wear on the boilers. But it must be remembered that the thousands of household chimneys contribute their quota to the mass of smoke. The extent of the household contributions is measured by the increase in sooty deposits in the winter time. Open grates are responsible for the most of this. Properly constructed grates and chimney passages will, however, do much to mitigate the evil, and we can look for amelioration here only in those fireplaces newly erected. No one cares to go to the expense of having his fireplace changed to lessen the soot on his neighbour's family wash, and that is about the English of it. "Smoke consumption," so called, is remediable, but the argument of economy of fuel is much less potent here, where fuel is so cheap, than would be enforced legislation compelling scientific combustion, domestic and manufacturing.—*American Inventor.*

ELECTRICITY AS A MOTOR.

Although the precise nature of electricity is not yet determined, it is known to be a form of energy, and many of the laws which govern its application to the production and transmission of power are understood. Although it cannot be said to be at present to any extent thus practically applied in this country, yet in France its use for the latter purpose is already an undoubted commercial success, and there is every probability that its universal adoption, under certain conditions, is only a matter of time Therefore it is highly important to compare it with the other "agents" in this case not being taken to imply anything material. In order to do this, however, a rather different treatment of the subject will be necessary to that previously adopted, as the machines which may be used, or which are at present used for other purposes, will not be described, but an attempt will be made to present a concise view of the conditions under which electricity must be employed, and of the experimental results recently published, so that the above comparison may be made. The original method of obtaining an electric current for the performance of work is analogous to the generation of steam in a boiler, fuel being used in both cases; but the energy represented by zinc, which is the substance commonly so employed, is only about one tenth of that which an equal weight of coal would produce. As the cost of zinc is about £25 per ton, and of coal only about 10s., the energy obtained from the former is about five hundred times as expensive as from the latter. However, as the efficiency of a small steam engine would be, perhaps, at the best, one-tenth that of a small electric engine, though often nearer one-twentieth, the final cost of the work performed would be from fifty to twenty-five times as great. These figures suffice to show why this method of producing electricity has been abandoned where power is required, and unless some cheaper substance than zinc can be obtained for the purpose, it is never likely to be readopted Nevertheless, ever since the discovery of Oersted (1820), which led to the manufacture of the first electro magnetic motor, there has been a continual production of such machines, though no attempts to apply them on a large scale have been made since the experiments of Jacobi on the Neva in 1838, whose engine developed about three-fourths horse power Yet, for many small purposes they have been adopted, especially in France, for working ruling machines, sewing machines, etc.; but it is a significant fact that the electric pen, in which an engine is actually present, though for a purpose requiring a minimum force, is about their only present use as motive power, even the manufacture of the latest and very efficient Howe electric machine, invented to drive sewing machines and developing about one-sixtieth horse power, having been now given up. There is another mode of producing an electric current, viz., by the expenditure of energy from any available source, such as steam or water power, on a magneto or dynamo electro machine The current so produced is identical in nature with that from a battery, but very different in cost —and upon this point turns the whole question of its possible introduction, for these are practically the only two methods of generating electricity.—*Mechanical Engineer*

THE MANUFACTURE OF PLATE GLASS

To cast, roll, polish, and burnish plate glass requires machinery of peculiar construction, and a "plant" that is costly by reason of its complex nature. The pouring of liquid glass from the furnace upon the cast iron plates, and the subsequent rolling, are processes comparatively simple. Any housekeeper who has used a rolling pin on a batch of pie crust dough performs an operation very similar to this stage of plate glass making It is the succeeding processes of grinding and polishing and final burnishing that require time and costly mechanism. After leaving the rolls and bed plate the glass is rippled and rough, and only fit for gratings or skylights. Each plate must be transferred to machines that resemble the turn tables of a railway. On the revolving platform the glass is cemented into a bed of plaster of Paris, and the machine started. Bearing heavily on the surface of the glass are blocks of metal, and while in motion the surfaces are kept supplied with sharp sand and a constant stream of water. The next stage of the glass grinding process is the same as the machinery, but instead of sand coarse emery is used. Then finer emery is used in another revolving table, and so on for half a dozen times. The final polishing is done by heavy reciprocating devices, fed with rouge, and maintaining a constant back and forward motion, and also a lateral movement over the service of the crystal. All this requires the assistance of a large force of men, many of them skilled labourers. After going through these different grindings and polishings the plate that measured an inch in thickness is only three-quarters of an inch thick, has lost all its roughness, and is ready for the show window of the purchaser.—*Pittsburg Telegraph.*

DIFFERENT VARIETIES OF STEEL.

The following current definitions of the different varieties of steel by William Metcalf, of the Crescent Steel Works, Pittsburg, Pa., are published in a circular by the Dexter Spring Co, of Hulton, Pa.:—

Originally the word steel was applied only to iron which contained such quantities of carbon as would cause hardening when the red hot iron would cool suddenly. This definition still applies, but in addition, the term cast steel applies to all of the products of the crucible, the Bessemer converter and the open hearth furnace, whether such products are too low in carbon to harden or not. The steels that are not cast steel are known in the market as blister steel, German steel, shear steel and double shear steel.

Blister steel is made by heating bars of wrought iron, bedded in charcoal, in hermetically sealed chambers. The carbon of the charcoal penetrates the hot iron, converting it into a crystaline mass of crude steel; large blisters rise on the surfaces of the bars, giving the name blister steel to this product.

German steel is blister steel rolled down into bars. It is used mainly for tires and common springs, and is being rapidly superceded by the cheaper grades of cast steel

Shear steel is made by taking a high heat on blister steel and hammering it thoroughly. Double shear steel is made by cutting up shear steel, piling it, heating it, then hammering again. The best shear steel must be made from the best wrought iron. The shear steels are very useful on account of their toughness and the ease with which they can be welded to iron, and when of good quality and well worked they will hold a very fine edge.

Crucible steel is made by melting in a crucible either blister steel or blister steel and wrought iron, or wrought iron and charcoal, or wrought iron and scrap steel, or, in short, a great variety of mixtures, which depend on the quality of steel to be produced Crucible steel can be applied to any purpose for which steel is used Generally it is better than any other steel—that is to say, crucible steel made by melting blister steel and tempered to suit by mixing iron of the same grade in the crucible is always better than German or shear steel made from the same blister.

Bessemer steel is made by blowing air through melted cast iron, thus burning silicon and carbon out of the cast iron. After the silicon and carbon are burned out melted spiegeleisen or ferro manganese is added to the charge. The carbon in the spiegel recarbonizes the steel to the desired point, and the manganese unites with and removes the oxygen which the air used leaves in the steel

Open hearth steel is made by melting in a very hot furnace a charge of pig iron To this melted iron, which is called the "bath," is added either wrought iron or scrap steel, or iron ore, and the whole is kept hot until all is melted The wrough iron, or scrap, or ore reduce the carbon and silicon in the bath to such proportions as are desired in the steel.

Bessemer and open hearth steel are much alike in quality. They are used mainly for rails, boiler plates, ship plates, bridge and other structural purposes and machinery. The better qualities are also used largely for springs. The best spring steel, like the best tool steel, is simply that which is made from the best material. Quality of material, chemically speaking, being equal, the best spring steel is that which is made from crucible cast steel, as the crucible process is less crude than either of the others.

A JAPANESE BRONZE WORKER

The most skilful living bronze worker in Japan, and one of the most skilful workers in metal that Japan has ever possessed, is said by the Japan *Mail* to be a Kiyoto artisan named Zoroku His speciality is inlaying with silver and gold, an art which he carries to such perfection that his pieces are scarcely distinguishable from the *chefs d'œuvre* of the Min period. What one sees on going into his *atelier* is a very old man—some 65 or 70—peering through a pair of huge horn spectacles at a tiny incense burner or still tinier flower vase, from whose frets and diapers he is paring away, with marvellous patience, an almost imperceptible roughness or excrescence. Beside him, winter and summer alike, stands a brasier with a slow charcoal fire, over which an iron netting supports one or two bronze vessels similar to that he holds in his hand. Plainly these bronzes are being subjected to a slow process of baking, and if you watch for a moment, marvelling at the purpose of a proceeding which seems only calculated to mar the fair surface of the metal, you shall presently see the old man dip a feather into a vessel filled with greenish liquor, and touch the heated bronze here and there with the most delicate and dexterous care. This liquid is acetate of copper, and this patient process, which you see repeated perhaps twenty or thirty times during a visit of twice as many minutes, will be continued in the same untiring fashion for half a year to come, after which a month's rubbing and polishing will turn out a bronze rich in green and russet tints that might, and indeed must, you would fancy, have been produced by centuries of slowly toiling time.

A new submarine cable, manufactured in Switzerland, has a single conductor, composed of seven copper wires, and the insulating envelope presents the notable peculiarity of being composed of cotton boiled in paraffine, and colophany—resin The copper conductor is surrounded by three layers of cotton, and as soon as the weaving of the cotton covering is finished, the wire is immersed for an hour in a bath of paraffine, at a temperature of 180 degrees C. By this means, it is stated, all moisture is expelled from the cotton, which then absorbs the melted paraffine. The cable is finally passed through a powerful press, which covers it with a leaden tube, the interstices which present themselves between the cable and the tube being hermetically filled with the resin

It appears, from various experiments with the oil lubricants now in use, that a mineral oil which flashes at less than three hundred degrees Fahr. does not possess the best qualities for lubrication, and it is unsafe in proportion to the lesser degree at which it flashes. Again, a mineral oil evaporating more than five per cent. in ten hours, at a heat of one hundred and forty degrees Fahr., is found to be hazardous in proportion to the increased percentage of volatile matter, and is also more unfit to be used as a lubricant the more rapidly it evaporates—because the remainder will either become thick and viscous, requiring a high heat in the baring to make it operate at all, or, if the oil does not contain such a residuum liable to become thick and heavy, it will leave the bearing dry

The decay of the wood of ships in those parts of the structure adjoining iron nails and bolts, while no such decay is usual where wooden or copper bolts are employed, is a fact of familiar occurrence. For the purpose of ascertaining the true solution of such a phenomenon, various experiments have been made, among which are those on the action of sesqui-oxide of iron on different vegetable products. The results of these researches, as made by French chemists, appear to prove that the sesquioxide brings the oxygen of the atmosphere into contact with the organic matter of the wood, and thus its destruction is hastened. The oxide becomes, in some degree, a kind of reservoir of oxygen, filling itself at the expense of the air and emptying itself to support the combustion of combustible bodies

The construction of a maritime canal along the Seine, between Havre and Tancerville, is now engaging the attention of French engineers This great artificial watercourse will begin at the extremity of the basins of Havre and will follow, without leaving the right bank of the Seine till it reaches a point which is called the Nars, or the Cape of Tancerville. It is to be twenty-five kilometres long, twenty-five metres broad at the bottom, and three m. fifty draught of water, this latter being some fifty centimetres greater than exists in the Seine between Paris and Rouen One of the desirable points is that from Harfleur to Havre the canal can be accessible to brigs, schooners and coal bearing steamers coming from Cardiff or Swansea, Sunderland or Newcastle—this requiring that the draught be carried to four m. fifty.

Professor Jenkins, an eminent English astronomer, has endeavoured to show a very remarkable effect of the planet Venus upon the earth The present astronomer royal of England proved many years ago, that the disturbing effect of this planet was so great that the earth was materially pulled from its orbit. According to Professor Jenkins it is to this action that an explanation must be looked for in accounting for the cold waves which have occurred, on an average, every eight years during the last half century, and in this connection the prediction is ventured by Prof. J that for the next forty years the temperature will be below the average He also states, as others have before him that a heat wave has been observed to pass over the earth every twelve years nearly contemporary with the arrival of the planet Jupiter at its perihelion

Investigations recently made of ocean temperatures show that the water of the North Pacific is, in its whole mass, colder than that of the North Atlantic, and that the water of the South Pacific is, down to 4,225 feet, somewhat warmer than that of the Atlantic, but below that depth colder. Again, the bottom temperatures are generally lower in the Pacific than in the Atlantic, at the same depths and in the same degree of latitude; but nowhere in the Pacific are found such low bottom temperatures as in the antartic portion of the South Atlantic, between thirty-six and thirty-eight degrees south and forty-eight and thirty-three degrees west longitude. In the western parts of the Pacific, and the adjoining parts of the Eastern Archipelago, the temperature of the water reaches its minimum at depths between 1,800 and 0,000 feet, remaining the same from this depth to the bottom.

The idea that fish food is especially adapted for brain nourishment, and that by inference, fish eating people are therefore more intellectual than the average of mankind, is scouted by no less authority than Dr. Beard. Referring to this wide spread popular notion, he terms it a delusion, utterly opposed to chemistry, to physiology, to history, and to common observation. He casts the responsibility for the almost universal acceptance of this delusion by the American people upon the late Professor Agassiz, "who impulsively, and without previous consideration, apparently, as was his wont at times, made a statement to that effect before a committee on fisheries of the Massachusetts Legislature. The statement was so novel, so one sided, and so untrue, that it spread like the blue glass delusion, and has become the accepted creed of the nation" A scientific writer observes that the generally received fact that phosphorus is essential to the nutrition of brain and nerves, is probably remotely connected with the utterance of the fallacy that Dr Beard denounces. The well known phenomenon of the glowing (or phosphorescence) of fish in the dark, especially manifest when they have been kept for some time, is popularly believed to indicate the presence of a large proportion of this nutritive element. Chemical analysis, however, fails to substantiate this idea, but demonstrates that the flesh of fishes contains a smaller proportion of mineral elements than other forms of flesh food. The phosphorescence likewise is in reality simply an evidence of commencing decomposition, it is not confined to fishes, but is shown by decaying vegetation as well.

The frog sellers who had hitherto rarely quitted the Central Market, may now be heard crying their merchandise in the streets of Paris. The edible parts of the frog are the hind legs, which are sold by the dozen on a skewer. The frogs are obtained by hunters armed with bows, the arrows of which are attached to a string, and thus perform the office of a harpoon.

James W Powell, a son-in-law of ex Congressman Young, of Kentucky, had been dangerously ill for months. One day he hobbled out of the house, barely able to move with the help of crutches and took a seat in the sunshine Like a stroke of lightning, and without any warning, he was thrown flat on his face by some invisible power. He arose perfectly cured. The explanation was that a prayer, made at a distance of ten miles, had been instantaneously answered.