feet long, and two feet six inches in circumference, and such a bundle weighed from eighteen to twenty-one pounds. The foreign bundles, bound together with wire, are usually much larger, forty or forty-five bundles making one tun. The sizes of the bundles are so regulated as to be conveniently handled or carried about, and the above sizes are usually agreeable to the powder makers.

From the dangerous nature of the manufacture, gunpowder works are always more or less isolated, and the land immediately surrounding the buildings thickly planted with trees and shrubs to lessen the force of the concussion in case of explosion—thus, for instance, the Messrs. Hall's works at Faversham are spread over six hundred acres of land, and much of this land is planted with alder and Rhamnus, more especially the former, for though the wood itself is not so valuable as the latter for the actual manufacture of powder, the tree is owing to its larger size, more effectual in obstructing fragments of burning timber as well as diminishing the force of the shock in case of an explosion. In some works it is the custom to stack the wood for a considerable period after being cut previous to using; thus, for instance, alder and willow would be kept for about three years, and dogwood for, perhaps, a still longer period. It has been found, however, that alder loses about twenty-five per cent of its weight in the first month after cutting, and then remains stationary; therefore the system of stacking for so long a time appears quite unnecessary.

While most botanical writers allude to the wood of the *Rhamnus frangula* as being *one* of the best for powder charcoal, they do not apply to it the name dogwood, but refer that wood to *Cornus sanguinea*, which has been generally, though it appears wrongly, accepted as furnishing the bulk of the wood used in the manufacture of the finer kinds of powder; alder, willow, and other woods, being still largely used for blasting and the coarser kinds of powder.

THE MANUFACTURE OF SULPHURIC ACID.*

From the Report of J. Lawrence Smith, United States Commissioner to Paris Exposition.

Furnaces for Burning Pyrites.—There is nothing specially new in the present construction of furnaces used for burning pyrites, but as these are scarcely used in America, but perhaps can be with advantage, it is well to refer to them here.

At first fuel was mixed with the pyrites to keep up the combustion, but this was soon abandoned, and it is found that pyrites in burning furnishes all the heat necessary to continue the combustion. The beds of pyrites are made quite thick; at Javelle, France, they are made over three feet thick, and the doors of the furnace are luted. The combustion goes on very slowly, so that forty-eight hours are required for the upper layer of the pyrites to descend to the grate bars. In this way most complete combustion is procured, and hardly two or three per cent of sulphur remain in the residue. However, to accomplish this complete combustion, the pyrites must be in lumps; but as the pyrites is obtained about 10 per cent of it is more or less pulverized, constituting one of the annoyances in this method of making sulphuric acid.

Various methods and furnaces are in use for the combustion of this fine pyrites, and they accomplish the result more or less perfectly.

The furnace of Spence, used almost universally at Manchester, is probably the best for this purpose. This furnace is a very long one, from forty to fifty feet long by six feet wide, and inclined about fifteen inches downwards. The floor of the furnace is of large flat tiles, and is heated from below by a lateral furnace three or four feet in advance of the lowest part. The fine pyrites is introduced by an opening in the top of the furnace, and is spread by means of rakes introduced through a lateral door only opened during the raking, and when it is necessary, by skillful movement, to push forward the pyrites to the lower part of the furnace. After being allowed to cool, it is drawn out of the furnace at the front part, through an opening that supplies the requisite quantity of air by adjustment.

The roasting lasts about twenty-four hours—the furnace having twelve doors on the side, and two hours being allowed to the pyrites between each door before it is pushed forward. It is said that the fine pyrites can be made to give up all but two or three per cent of its sulphur, a result not far from what is realized with that in lumps; and when it is remembered that this fine pyrites bears a less price than that in lumps, these results are certainly of vast importance to the large factories. Kuhlmann, in his process, mixes the fine pyrites with clay, and makes small balls or cakes, that, after drying, are used in the same furnace in which he burns the lump pyrites. Five per cent of clay is sufficient to mix with the fine pyrites to form the little balls, and they can be made at a cost of about forty cents a tun in France.

The furnace that Michael Perret has introduced for burning fine pyrites in several establishments in France is highly spoken of. Instead of using the long furnace of Spence, he divides the furnace into a number of shelves, with large fire tiles, six centimeters thick and ten centimeters apart, and so placed in the masonry that the hot air and gases proceeding directly from the pyrites in lump, burning in the ordinary furnace, circulate back and forth (ascending all the time) over these shelves, on which the fine pyrites is spread to a depth of three centimeters. We may have ten or more of these shelves, until the furnace becomes inconveniently high. The operation lasts thirty-six hours, and each furnace can burn one tun of fine pyrites. This system is said to require one per cent more of niter in the subsequent operations.

Furnace of Gerstenhoffer.—We cannot omit giving a passing notice of the furnace of Gerstenhoffer, of Freiberg, which is employed by the Vieille Montagne Company, of France, and also at Swansea, in Wales. At the last-named place it is used for desulphurizing copper ores containing 30 per cent of sulphur, and from which they are now collecting the sulphurous acid and making sulphuric acid.

The furnace is composed of a quadrangular tower eighty centimeters square and six meters high, closed at the top, except a long, narrow opening extending from one side to the other. Above this opening is placed a hopper of the same length, provided with two feel rollers at the bottom, the movement of which feeds the furnace with pulverized pyrites. This pyrites, as it enters the furnace, falls on a triangular prism or cross-bar of brick fastened horizontally to the walls of the furnace, with its base uppermost. The powder gradually accumulates on this horizontal face, so as to make a pile with a triangular section, the base of which covers the face of the prism. After a short while the pyrites falls over on each side of the prism in two thin sheets, which, in descending, meet with two other prisms below so placed as to intercept it and cause it to accumulate again, and afterwards to fall over in four sheets, and so on. By successive descents over as many as twenty prisms the pyrites is brought thoroughly in contact with the heat and air of the furnace, and by the time it reaches the bottom there is not more than four or five per cent of sulphur left in it. By openings, closed by movable stoppers in the side of the furnace, the process of oxidation of the pyrites can be seen, and the influx of air can be regulated.

Utilizing the Residue from the Pyrites Furnace.—This residue, notwithstanding the little sulphur remaining in it, is used in the high furnace, mixed with ores for the production of iron. Mr. Bell, near Newcastle, and Perret in his operations, has shown that by the addition of a little common salt in the desulphurizing process, iron of a good quality can be made from this material. When this waste product from the manufacture of sulphuric acid becomes useful in a remunerative industry, another great impulse is given to the production of this acid from pyrites.

The Use of Fluxes in the Reduction of Iron Ores.

The principle upon which the use of all earthy fluxes is based, is, that, practically, no earth is fusible alone; argillaceous and silicious earths together are infusible, so with argillaceous and magnesian—so with silicious magnesian, but, when calcareous earth, lime, or limestone, is added to any mixture of the other two, all will combine and run into glass, which will become thin, with the same heat, according to the skill in proportion and treatment.

M. D'Arcet, a French chemist, made this experiment: He put into three crucibles, respectively, a ball of clay, a quartzose, or silicious sandstone ball, and a limestone or chalk ball, and exposed them to heat so great that the chalk ball fused slightly, where it had touched the sides of the crucible. They were unmelted. He then mixed them, and, in the same fire, they ran into a thin and transparent glass.

Kirwan found that argillaceous and magnesian, argillaceous and silicious, and silicious and magnesian earths would not melt in any proportion, but that silicious and calcareous earths, argillaceous and calcareous, by very strong heat, would vitrify, but not perfectly. When the earths are calcareous, argillaceous and magnesian, it requires a double proportion of the calcareous to make a glass. No glass can be made if the clay earth, or magnesian predominate. It has been found that the calcareous earth, argillaceous and silicious earths, or calcareous, magnesian, and silicious can be brought into perfect fusion, if the calcareous somewhat predominate. With a strong heat, argillaceous, silicious, and magnesian earths may form a glass without lime, and this is the only combination he tried that would thus produce glass without lime.

The metallic oxides (iron, of course, included) aided the fusion. Note, that, common clay sometimes contains one half, or more, of its weight of sand intimately mixed. If clay predominate in the iron ore the flux indicated is limestone, and if the iron be, on the contrary, mixed with limestone, the proper flux is not limestone, but clay.

Herein consists much of the practical knowledge in mixing ores so that they may flux one another, which are with difficulty fluxed alone.

Hence the necessity of a knowledge of the composition of ores to prevent the loss of fuel, of time, and of iron, by the iron becoming entangled in the scoria, or in a thick unyielding slag.—*Osborn's Metallurgy of Iron.*

Chemical Fire Engines.

Engineering states that the principle of extinguishing fires by the use of water saturated with carbonic acid, has recently been extended by a Glasgow firm to engines, which can be worked either by manual or steam power, in such a way that the component parts required for the generation of the gas are forced separately into a vessel within which they mix, and pass beneath the self-created pressure through the hose and nozzles in connection with the machine. The apparatus comprises a wheeled carriage, the body of which is in the form of a tank made with sheet iron fixed upon angle-iron frames, and which is divided into three compartments. Pumps are fitted into the compartments, and are arranged to be actuated by a beam, on a rocking shaft which is provided with the usual levers for the application of manual power. The pumps may, however, be worked by a portable steam engine, as in existing steam fire engines. The communications with the pumps are so arranged that they may draw from the tank compartments, by openings, in which case the liquids used are filled into those compartments, that is, the solution of carbonate of soda or other suitable carbonate is filled into one compartment, and the solution of tartaric acid is filled into the other compartment. Or the openings may be closed and the liquids may be drawn from other tanks or vessels by means of hose coupled to the ends of the pipes projecting out through the back of the carriage for the purpose. Air vessels, for equalizing the flow of the liquids are applied to the suction pipes. The delivery pipes from the pumps lead into a strong vessel in the front compartment, and in connection with this vessel there is a single delivery pipe, upon the projecting end of which the hose is to be coupled for leading the gas and water to the fire. A vessel receives the two liquids delivered by the pumps, and these liquids act upon each other in the vessel or generator, as it may be termed, and generate or set free the carbonic acid of the carbonate employed. This carbonic acid passes off along with the liquid and is by the hose directed upon the fire, against which it is thus in a most effectual manner made to exercise its well-known extinguishing power.

The arrangement of the various parts of the apparatus may be modified, and will depend more or less on the power intended to be developed. Thus the chemical liquids employed may form only a part of the liquid employed by the engine, water from any ordinary source being also pumped into the generator or delivery pipe either by separate pumps or by the same pumps; separate suction pipes being used in the latter case with valves or cocks to regulate the quantities of chemical liquids drawn in along with the simple water. Or, on the other hand, the two chemical liquids may be forced into the generator by separate and distinct pumping engines arranged upon the same or separate carriages.

The experiments which have been conducted with this machine show that it possesses in an extended form the merits of the smaller apparatus. The water and carbonic acid gas combined produce a far greater effect upon a fire than an equal bulk of unmixed water—an important consideration, for it happens not unfrequently that the means used for the extinction of fires are productive of as much damage as the fires themselves. A series of trials will shortly be conducted with the new chemical engines, and we shall then be able to ascertain the advantages they will actually offer over ordinary engines.

Damp Walls.

"Our attention," says the *Mechanics' Magazine*, "has of late been called to the question of rendering the walls of buildings impervious to moisture. We have received letters upon the subject from correspondents who ask us to point out a remedy for the evil. We, therefore, gladly take the opportunity of making known to our readers that there is a remedy, at once simple and efficacious. This is a process invented by Mr. Frederick Ransome, and which is being successfully carried out in practice by the Patent Stone Company, East Greenwich. It consists in the employment of colorless mineral solutions which possess the property of forming an insoluble and indestructible mineral precipitate when applied to buildings. The deposit takes place not only on the surface of the material to which it is applied, but enters the body of the substance. The application of the solution in no way alters the color of the material, a perfectly natural appearance being preserved in the building. The effect is permanent, neither atmospheric nor saline influences in the least degree affecting the indurating material. It not only renders the building water-proof, but it further most effectually indurates and preserves from decay the stone or bricks treated with it. This process has recently been applied to several buildings which are stated to have been untenantable, previously to the application, on account of exposure to a wind-driven rain. Paper now hangs well on the walls from which it formerly drooped in festoons and tatters, while dryness and a cleanly appearance have taken the place of dampness and mildew. This process of rendering buildings impervious to wet is comparatively inexpensive, therefore no one need longer to suffer from that source of discomfort and danger to health—damp walls.

Narrow Gage Railway.

The Portmadoc and Festiniog Railway, Wales, is now attracting much attention from railroad men. This is a little line in North Wales, which was originally constructed for the purpose of acting as a tramway for slate and stone from the hills of Merionethshire to the sea shore. It is now being used as a regular goods and passenger line. The chief peculiarity in its construction is that the gage is only two feet broad. Hence, though the line runs through a very difficult country, the expenses of construction and working are so small that the traffic yields the enormous revenue of thirty per cent. The reason is simple enough. It is because the proportion between the dead weight and paying weight is so much less than upon other railways. The engine and tender upon this line weigh about ten tuns, against forty tuns upon the wider gage of other lines. Instead of a first class carriage weighing seven and a half tuns, to carry thirty-two passengers, and representing nearly five cwt. of dead weight for each passenger, the carriages on the Festiniog weigh only thirty cwt. for twelve passengers, or two and a half cwt. for each person carried.

EFFECT OF STEAM HEAT ON HAY.—A correspondent from Rancocas, N. J., favors us with a specimen of hay wrapping which had been on a steam pipe for nine years; the pipe carrying steam at fifty-five lbs. The specimen is of a chocolate brown and very friable; but it burns no more readily than well dried fresh hay, although its appearance would seem to indicate great combustibility. We should have less fear of its ignition than of pine wood similarly carbonized.

Improved Implement for Opening Cans.

The want of a perfectly efficient, handy, and light tool for opening tin cans containing fruits, vegetables, etc., has been long felt. The practice of preserving fruits, meats, etc., in this manner has become general, and something of this kind is needed in almost every house.

The engraving tells its own tale. The instrument consists of two small levers, A and B, pivoted together at C. The pivot, C, is bent at right angles, and made sharp to act as a center punch.

Two blades, D and E, are held by clips and set screws to these levers, one blade being set at right angles to the other, These blades are adjustable to different diameters of cans.

In use the instrument is seized with both hands in the manner shown in the engraving, the center, C, is first punched vertically through the top of the can. The handles are then brought to a horizontal position, and the blade, E, is thrust through the tin, making a radial cut, shown at F. The center, C, and the blade, E, now hold the can from turning, while the lever, A, is made to perform a complete revolution, carrying with it the blade, D, and cutting out the top in a remarkably neat manner.

There is no liability of the can's turning, as in the case with many instruments made for this purpose, and thus a great annoyance is completely obviated.

Patented through the Scientific American Patent Agency, Oct. 19, 1869, by W. M. Bleakley, whom address for further information at Verplank, N. Y

BLEAKLEY'S CAN OPENER.

Steam on Common Roads.

In England, steam begins to be used on the common roads. A gentleman writes to the *Times* stating that he has received a visit in the dead of the night from a friend, who with four members of his family arrived in a steam wagonette. The reason for selecting that unearthly time for the visit was the existence of a law forbidding the use of steam carriages on the public thoroughfares except between the hours of ten at night and six in the morning, also limiting them to a speed of two miles an hour, and requiring them to be preceded by a man sixty yards in advance bearing a red flag. The writer suggests that these precautions are unnecessary, and that steam locomotives should be allowed the use of the roads at all hours, with no other precaution than a limitation of speed to twelve miles an hour. On this the *Pall Mall Gazette* remarks:

"If steam wagonettes are coming into general use, we earnestly hope that there may be some modification of the law referred to, but only for the sake of the visited. We are all delighted to receive morning visits from our friends, but there are cases in which we should be more delighted to be let alone, and we tremble to think what will be the effect of a host of visitors arriving in the early hours of the morning in steam wagonettes at the rate of two miles an hour, preceded by heralds with red flags. Why not transfer these restrictions from steam carriages to wagons, which are the cause of most of our street accidents? It would be an admirable plan to limit the speed of these vehicles and insist on their being preceded by a signal of danger."

The New York and Brooklyn Bridge.

The contract for building the caisson or foundation work of the bridge on the Brooklyn side has been awarded to the firm of Webb & Bell, of Greenpoint. The cost, with the necessary timbers, is to be about $200,000. The work is to be commenced immediately under the general superintendence of Mr William C. Kingsley, of the firm of Kingsley & Keeney. The central part of the tower on the Brooklyn side will be located at the upper slip of the Fulton Ferry. All the woodwork of the old docks and piers will be torn up, and every thing removed to low water tide. The bottom of the river will then be excavated to a depth of 22 feet below high tide, until a level area is obtained for the reception of the caisson. The dimensions of the caisson, the space to be thus cleared and leveled, is 170 feet long by 102 feet extending out into the river toward New York. The 102 feet front of the caisson, facing that city, will be on a level with the bulk head line as established by the Harbor Commissioners. The mass of large boulders with which the bottom of the river is believed to abound will be removed by blasting, and the pieces removed by powerful dredging machines. Experiments which have been made on the quicksand bed of the East River, while excavating a dry dock, prove its bearing power to be ten tuns per square foot. By Mr. Roebling's plan, it is proposed to rest upon this bed a weight of only four tuns per square foot. The weight of each tower is to be somewhat over 75,000 tuns. To distribute this vast weight so that no part of the pressure on the base shall be over four tuns per foot, it has been decided that the area of the foundation shall be 170 feet long by 102 feet broad. This area will be composed of huge timbers resting on the sand, and bearing the masonry work of the tower upon it. The timber will be 30 feet thick, and this vast mass of 20 feet by 170 by 102 will be securely bolted into one solid frame, so that the weight of the tower above can never deflect in the slightest degree at any point. The caisson, when launched, will draw 17 feet of water. It will be 170 feet long, 102 feet wide, and 15 feet deep, with a top five feet thick, and sides of a thickness tapering from 9 feet at the top to a foot below. The time required to build it will be about four months. As soon as it has been set afloat it will sink to within eighteen inches of the surface of the water and when the proper time arrives it will be towed down to the ferry and placed in position ready for being submerged. This is to be accomplished by building on the top of the caisson successive layers of timber and concrete to a hight of 20 feet. The weight of the caisson with this 20 feet of timber and cement above the "air chamber," will be 11,000 tuns.

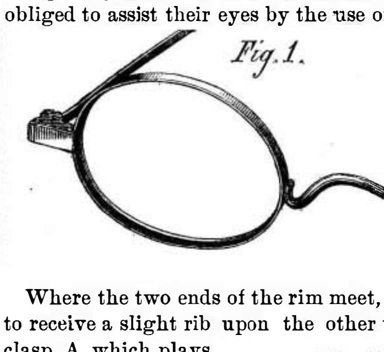
The material excavated is hoisted from the "air chamber" through two water shafts by means of dredges, and as it is raised the caisson sinks, being uniformly undermined round the four edges and throughout its whole extent. As the caisson thus gradually sinks the mason work, inclosed in a cofferdam, is in progress on the top of the timber, thus adding the necessary weight. Access is had to this "air chamber" by means of two air shafts three feet in diameter. The depth to which it will be probably necessary to go into the bed of the river, will be about 55 feet below high water mark, so that all the timber of the foundation will be inclosed in the sand and other material through which an excavation has been made.

IMPROVEMENT IN FRAMES FOR SPECTACLES AND EYE GLASSES.

Some of our readers will be much interested in the simple but valuable improvement illustrated in the accompanying engravings. Many of them have been annoyed by glasses coming out of the frames, and have been sorely bothered in the absence of proper implements to replace them.

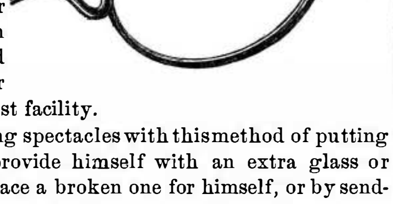
In the case of spectacles with spring frames, should the spring chance to break, it is difficult for people under ordinary circumstances to repair them, and much annoyance often results from the loss of time necessary in sending them to a jeweler.

The present device obviates all these annoyances, and will add greatly to the comfort and convenience of those who are obliged to assist their eyes by the use of glasses.



Figs. 1 and 2 show the improvement as applied to the old style of spectacles; Fig. 1 exhibits the rim which holds the glass closed, and Fig. 2 the same unclasped for the insertion of a glass.

Where the two ends of the rim meet, Fig. 2, one is grooved to receive a slight rib upon the other which fits into it. A clasp, A, which plays upon the same pivot as that upon which the side bows play, when closed over the end of the rim, B, holds it in place far more securely than the old screw, and may be opened or closed with the utmost facility.



A person purchasing spectacles with this method of putting in the glasses, may provide himself with an extra glass or two, and at once replace a broken one for himself, or by sending the number to the makers he may obtain a glass to correspond and insert it himself without the slightest trouble.

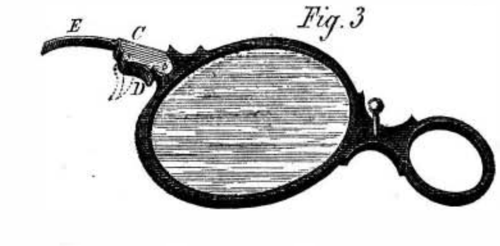


Fig. 3 shows an improved method of attaching the springs to eye glasses. A small metallic clasp, C, is riveted to the rim. To this clasp is pivoted a small lever eccentric, D.

This lever eccentric, when opened into the position shown by the dotted lines, releases the spring, E, which is not pierced for rivets, as such springs have hitherto been. When the eccentric is closed it holds the spring securely, and the liability of the spring to break at the point where it is riveted in the form heretofore employed is obviated, the spring being as strong in one place as another. Should it break, however, at the point of junction, the eccentric may be opened by the thumb nail, the end of the spring reinserted, and the glasses can then again be used, the only inconvenience being a slight shortening of the spring, scarcely perceptible to the wearer.

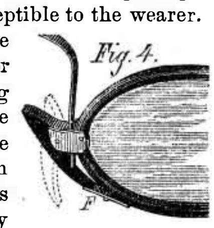


Fig. 4 is an application of the same principle to another form of frames for spring glasses, the lever eccentric being in this case identical with the piece formed to rest against the side of the nose. The manner in which the spring is clasped is sufficiently well shown to render description unnecessary; the dotted outline showing the position of the lever eccentric when open; this eccentric when closed being held from opening by a small metallic button, F.

The advantages claimed for this improvement, and which we are satisfied are fully attained, are very much greater convenience to the wearer, the ready insertion and interchangeability of glasses, greater strength, without any decrease in grace and lightness, as the addition of the clasp gives scope for ornament rather than otherwise, and the easy replacing of the glasses, or the springs when broken, *without tools.*

We have been much pleased with this improvement, and the inventor informs us that it is intended to make standard size glasses, so that glasses may be sent by mail to replace such as may be broken, all the required information being the number of the glass to be replaced. This will prove a great convenience to those at a distance, and will save much trouble.

Jewelers and others who keep spectacles for sale will also find this form of bows a great convenience, as, when a peculiar style of frame pleases a purchaser, and the glasses are not right, an interchange of glasses is but the work of a few seconds, which may be done as well at the show case as the work bench.

Patented through Scientific American Patent Agency, Oct 19, 1869. For further information, address the patentees, Louis Black & Co., Detroit, Mich.

Coal and Coal Mines.

Dr. Hill, of Queen's College, Birmingham, England, in a recent lecture on the "Chemistry of the Mine," made some interesting remarks on coal and coal mines. He said:

"The history of these formations was most interesting. Their age must be very great, as they have never been found with any traces of human remains. The principal animal forms were of a much lower type, consisting of snails, fish, reptiles, and insects. The impressions they have left, and the skeletons of them which remain, show that they were of a similar character to what are now known as "horsetails" pines, resembling the *Araucaria* of gardens, ferns, club mosses and a sort of palm. These were all of great size, the ferns branching to a hight of 50 feet; and the club mosses, now insignificant, were then 60 or 70 feet high. Taking into consideration the gigantic dimensions of the different plants, and the branched character of the ferns—such as only grow in hot climates—led them to conclude that England must at one time have had a tropical climate. A period when such rapidly growing and enormous plants of unlimited number existed is thus seen to have been highly favorable to the formation of those immense stores of vegetable matter—which may have been like peat beds, or carried on by river currents to their present beds—forming coal. There was no doubt but that coal was changed wood, such change being due to moisture, heat and pressure. They might look upon wood as carbon, hydrogen, and oxygen. As soon as a plant died it began to decay, and then the three elements entered into new combinations to form compounds which did not exist in the original wood. One part of the carbon entered into combination with part of the oxygen to form carbonic acid; another part combined with some of the hydrogen to form carbureted hydrogen, or "fire-damp;" while the remaining carbon, having no more oxygen or hydrogen to combine with, remains and constitutes black coal. If there were enough oxygen and hydrogen in the wood to combine with all the carbon, probably it would have been entirely removed by the same process, and there would have been no coal measures. Anthracite coal was that which had advanced furthest, and was most completely carbonized. They could easily understand after that how it was that coal had been formed, and also how carbureted hydrogen, the dangerous "fire-damp," was generated and confined in fissures in the coal, where there had been no outlet into the air. Fortunately it did not often appear among them. Coal was found at almost all elevations, from 8,000 feet above the level of the sea to 1,800 below it, as at Whitehaven, where, in addition to its depth, it is worked under the bed of the ocean for nearly a mile. It is, therefore, nearly certain that there are immense stores of coal existing at depths and in positions which render them inaccessible. Carbonic acid, known to the miners as choke-damp, is produced when carbon is burned with a sufficient amount of air or oxygen."

THE Crown Prince of Prussia is said to have invented a new apparatus for the manufacture of vinegar.