English, Welsh, and Scotch coals. A bushel of coals weighing 84 pounds has been made to generate a mechanical effect of 120,000,000 foot-pounds, although probably not more than 100,000,000 are generally developed.

We find this article already too much extended to admit the discussion of the various methods adopted by Joule to to demonstrate the mechanical equivalent of heat. At some future time we will make these experiments the subject of another article.

EVERY PANE OF GLASS IS A HOLE TO HEAT.

The sentence which forms the caption of this article we remember from a popular lecture on heating and warming buildings, delivered by a man who has done much towards educating the American public on matters of domestic economy and hygiene.

Some of our correspondents are asking for information upon the subject of how the solar rays get through panes of glass without heating them. Even in the coldest weather when the glass is below zero in temperature, the heat of the sun passes in, and—we may also add—the radiant heat of a room passes out more or less, without materially altering the temperature of the glass.

The ultimate cause of this phenomenon, which, we may say, is not confined to glass alone, is not yet understood, although it is doubtless dependent upon the molecular structure of the glass. The properties of bodies by which they permit heat rays to pass through their structure freely is called diathermancy. This property glass possesses in a far less degree than many other substances.

The most remarkable diathermanous solid is rock salt. It permits heat from all sources to pass as readily through it as light passes through glass, and hence it has been called the "glass of heat." As a rule the most diathermanous bodies are transparent substances of little density, such as air and the gases. On the contrary, transparent substances of great density interfere with the passage of heat. Among these may be classed glass, rock-crystal, alum, water, heavy oils, etc.

Those bodies which intercept the passage of heat are called athermanous, but the terms diathermanous and athermanous are not very definite in their application, except when applied to bodies which transmit or intercept heat in a marked degree.

One of the most powerful athermanous bodies is alum. This substance is as remarkale in athermanous quality as rock salt is in its opposite character in this respect. Alum, although it be made into a very thin plate, transmits very little heat from any source, although it does not intercept light to any great extent. A piece of smoked quartz permits heat to pass quite freely, although scarcely any light can penetrate it. On the contrary, sulphate of copper, though it permits the passage of blue rays of light freely, almost totally intercepts the passage of heat.

These facts are well established by experiment, and a great many others of a similar character might be mentioned.

The formation of any good theory as to the causes of diathermancy and athermancy is rendered more difficult by the very peculiar modifications in the power of heat transmission consequent upon the source from which the heat is derived.

Thus while glass allows solar heat to pass without difficulty, and while, as above stated, it does not become heated in the rays of the sun, it will in a great measure intercept heat derived from terrestrial sources, and become itself heated. So we see that although "a pane of glass is a hole to heat," it is a hole through which heat enters more freely into than it flows out of an apartment.

It is, moreover, found that heat from various terrestrial sources passes through diathermanous bodies with different degrees of facility. Thus, plate glass will transmit no heat from copper at 212° Fah.; but from copper at 750° Fah. it transmits 6 per cent; of heat from ignited platinum it transmits 24 per cent; and from the naked flame of an argand oil lamp 39 per cent.

It is also found that the diathermancy of solids increases with the degree of polish of their surfaces. But what is most singular of all is that heat which has been transmitted through a diathermanous body is thereby rendered more transmissible through succeeding diathermanous bodies. Thus a larger per cent of the heat which has passed from a lamp flame through a glass chimney, will pass through another diathermanous body than would be transmitted from the naked flame.

These are only a few of the facts connected with this interesting subject. As we have said there is yet too little known of the molecular constitution of bodies to give ground for anything more than speculation as to the cause of the various degrees of facility with which substances transmit heat.

ENGINEERING PROJECTS.

Rapid and comfortable transit through New York seems to be a problem upon which many distinguished engineers are working. In addition to the Pneumatic Tunnel of which we have lately said so much, we now have it announced that the New York City Central Underground Railway is to be proceeded with at once. It is said that a contract for the construction and equipment of the road from the Battery to the Harlem River has been completed.

George B. McClellan, William J. McAlpine, Egbert L. Viele, Julius W. Adams, Sylvester Sweet, I. F. Quinby, and John B. Jarvis having been requested as a Board of Engineers "to consider the question of a subway under Broadway, in the City of New York, with the view of relieving that street rom its present interruptions, and of affording a more convenient and speedy transit for passengers and for merchandise, without injury to the property upon the line of the street, or diversion of the established classes of business thereon," have submitted a report in which they say that a Sub-Arcade Railway will accomplish the objects desired. They think there are no difficulties attending the construction of the work which can not be overcome with engineering skill, and at a comparatively moderate cost; and that it meets a necessity in the most complete and unobjectionable manner. The estimated cost is from $1,600,000 to $2,000,000 per mile.

Marshall O. Roberts, William G. Ogden, Origon Vanderburgh, John I. Blair, Dudley Field, and John D. Sherwood, together with such persons as may become associated with them, have been created a body politic in deed and in law, by the name of the New York Port Submerged Railroad Company. They are empowered to survey, locate, and construct a submarine tunnel tube, or covered way, in or beneath the beds of the Bay of New York and of the Hudson River, from some point in New Jersey opposite the City of New York to some point in the City of New York, with one or more tracks herein to transport by rail or otherwise, freight and passengers, with the privilege of charging and collecting toll. They are not, however, to interrupt the free navigation of the waters. The penalties for obstructing or injuring such marine tunnel are a fine not exceeding $5,000 or imprisor ment not less than sixty days, nor more than one year, or both, besides paying the amount of the damage.

SCIENTIFIC INTELLIGENCE.

THE NASCENT STATE.

For a long time chemists have been in the habit of employ ing the word "nascent" to indicate the birth of a body in certain decompositions. The precise meaning they ascribe to it has never been very clearly understood, but the word has been retained as a convenient one for hiding our ignorance. Professor Henry St. Claire Deville objects to its use; he thinks we ought to be able to give a precise and exact definition to every expression employed in science, and this is not possible with the word nascent. He states his reasons in an elaborate paper, an abstract of which we shall give to our readers hereafter.

MANUFACTURE OF FERRO-CYANIDE OF POTASSIUM.

Dr. Emil Meyer recently read a paper on this subject before the Chemical Society of Berlin, from which we make a few extracts:

By the heating and melting of animal matter with potash, only cyanide of potassium is produced; the ferro-cyanide is first formed by the action of the carbonate of iron or hydrated oxide of iron in the solution. This transformation is better accomplished in very dilute liquors. The author recommends the use of carbonate of iron prepared from the chloride by lime and warns against the presence of sulphuric acid. Pure carbonate of potash should also be selected. It is better to conduct the fusion at a high temperature with as much exclusion of the oxygen of the air as possible, and to introduce the animal refuse, previously dried, into the fused potash.

This important branch of industry is very little pursued in the United States, although the yellow ferro-cyanide of potassium has extensive applications.

REFINING CAMPHOR.

Crude camphor is adulterated with common salt, sulphur, vegetable matter, tar, and water. Its purification can be best accomplished by sublimation in glass flasks of a capacity of 8 to 10 pounds, at a temperature of 400° Fah. These flasks are made of thin glass with flat bottoms and short necks. They are put into a sand bath, where a uniform and rapid heat can be applied. The crude camphor is broken up, mixed with 3 to 5 per cent freshly-slaked lime and 1 to 2 per cent iron filings, well sifted and introduced through a funnel into the neck of the flasks. The flasks are then put into the sand bath, covered with sand to the neck, and heated gently for half an hour to expel the water. As the temperature increases, the camphor softens, and finally melts. After the whole mass has become fluid the sand is removed from the upper part of the flask and a paper stopper put in to partially close it. The heat is then carefully preserved at a point sufficient to sublime the camphor but not to re-melt it. In this way a very pure article can be obtained.

LIMIT OF THE HUMAN VOICE.

A learned professor, who appears to have had nothing better to do, has been making calculations of the distance to which the human voice would reach if it were as powerful in proportion to the size of the animal, as is the case with the grasshopper. The grasshopper makes himself heard $\frac{1}{16}$th of a mile. An ordinary man weighs as much as 26,000 of these insects, and if his voice were proportionately powerful could be heard for the distance of a thousand miles. Such an arrangement would enable us to dispense with the telegraph and facilitate the abolition of the franking privilege, as the honorable member from Smithtown could address his constituents directly from his seat in Congress; it might have its disadvantages, as, for example, if one were to accidentally sneeze, the roof of the house might be landed in the neighbor's lot, and the walls of the house be generally dislocated. Upon the whole, as "silence is golden," and the telegraph answers every purpose, we are satisfied with the present limit of the voice, and propose to leave the grasshopper in possession of the field.

NEW TESTS FOR PHOSPHORUS AND SULPHUR.

A German chemist, M. Schoen, suggests the following new tests: To detect phosphorus in organic or inorganic matter, mix the solid substance with half its weight of finely-divided magnesium, and heat in a glass tube closed at one end. The mixture becomes phosphorescent, the sides of the tube will be covered with red phosphorus and another portion of phosphorus will combine with the magnesium to form the phosphide of that metal. After cooling a few drops of water will evolve phosphureted hydrogen. As the magnesium will not combine with sulphur the search for this element can be made in the same mixture by sodium or potassium. All compounds of sulphur, whether organic or inorganic, are decomposed by potassium and sodium to form alkaline sulphides. Place the substance to be tested in the bottom of a small glass tube, put in a few pieces of sodium, and add another layer of the substance, and heat gently. After cooling, project the contents of the tube into acidulated water, when a disengagement of sulphureted hydrogen will at once betray the presence of sulphur, or the nitro-prusside of sodium will afford a purple coloration if any sulphur be present. These two tests are probably the most delicate of any hitherto suggested for the detection of phosphorus and sulphur.

SEPARATION OF COBALT.

Keep up the neutrality of the solution containing the chloride or sulphate of cobalt by suspending in it the carbonate of manganese, then pass sulphureted hydrogen gas through the boiling liquor, when all of the cobalt will be precipitated.

COMPOSITION OF THE TAM-TAM AND CYMBAL.

M. Riche, in his researches on alloys finds that the tam-tam and cymbal are made of bronze that can be worked cold the same as iron or aluminum bronze. The best tone is produced by an alloy composed of 78 parts of copper and 23 parts of tin.

EXPLOSIVE COPPER COMPOUND.

Some years ago, when copper pipes were used for the conduction of illuminating gas through dwellings, small crystals were found to collect in the pipes, which proved to be highly explosive, and were shown on analysis to be composed of acetylene and copper. Recently a French chemist has discovered that the same explosive mixture can be produced by passing illuminating gas for some time through a solution of the nitrate of copper. The observation is a recent one, and may lead to the invention of a process for the manufacture of a new explosive compound.

Death of William W. Cornell.

This well known and highly esteemed citizen of New York died at his residence, on Washington Hights, on the 17th inst., of typhoid fever. Mr. Cornell began life depending entirely upon his own energies. He served a regular apprenticeship of seven years at the business in which he subsequently became distinguished. In 1847, in partnership with his brother, J. B. Cornell, he established his iron foundery, employing at first, by reason of the small capital possessed, but one man. The original manufactory was located on Center street. Here the business of the deceased gradually increased until at the end of ten years it had attained to such large proportions that it was necessary to move to another locality. During this year the firm constructed their great foundery on Twenty-sixth street, between Tenth and Eleventh avenues, and which has since remained the principal one owned by the brothers. Mr. Cornell's name is conspicuously associated with the progress of the use of iron as a building material, many of the best known edifices in the country having been constructed by him. Among them we can name the United States Custom House at Savannah, Ga., the Sun Atlantic Mutual Insurance Company, A. T. Stewart's, H. B. Clafflin & Co's, Bank of New York, Bank of Commerce, Union Bank, Ball & Black's, and the New York *Herald* buildings. These are but a few of the many fine structures which will long remain monuments to the skill of the firm of J. B. & W. W. Cornell. Indeed, owning as the deceased did, the most extensive and completely equipped works in the United States for the construction of fireproof building, it is not surprising that he, with his brother, held the foremost position among our iron founders.

In his private life Mr. Cornell was distinguished for many sterling and amiable traits of character, and was very liberal in his gifts, especially to the Methodist Church, of which he was a member.

Re-Sharpening Files.

A very interesting and economical process has been exhibited before the Société d'Encouragement, of Paris, by M. Werdermann. Well-worn files are first carefully cleaned by means of hot water and soda; they are then placed in connection with the positive pole of a battery, in a bath composed of forty parts of sulphuric acid, eighty parts of nitric acid, and a thousand parts of water. The negative pole is formed of a copper spiral surrounding the files, but not touching them; the coil terminates in a wire which rises toward the surface. This arrangement is the result of practical experience. When the files have been ten minutes in the bath they are taken out, washed, and dried, when the whole of the hollows will be found to have been attacked in a very sensible manner; but should the effect not be sufficient, they are replaced for the same period as before. Two operations are sometimes necessary, but rarely more. The files thus acted upon are, to all appearance, like new ones, and are said to be good for sixty hours' work. M. Werdermann employs twelve medium Bunsen elements for his batteries.

At a single blast recently made at Reed's Gap, on the Air Line Railroad, near Wallingford, Conn., 604 cubic yards of solid rock were thrown out. Thirteen holes, fifteen feet deep and three and a half inches in diameter, were drilled. Nitroglycerin was the explosive.