space. We give, therefore, an analysis of only one variety, the best English crystal glass, made by the chemist Berthier.

Silicic acid	59·20	parts.
Oxide of lead	28·20	"
Potash	9·00	"
Oxides of iron and manganese	1·40	"

Now it will be seen that in this glass there is iron, which we have stated gives a green color to glass; in fact it will be seen below that it is capable of giving many other colors; but it also contains manganese, which in common with arsenic possesses the property of decolorizing the alkaline silicates when colored by other metallic oxides.

This leads us to the means whereby color of any desired tint can be imparted to glass. In an article published in No. 2, current volume, an allusion was made to the use of the oxides of cobalt, copper, gold, etc., as surface colors for glass. When these and some other oxides are melted with the silicates, they become a part of the mass and color it throughout without impairing its transparency. Thus, oxide of cobalt gives a brilliant blue; oxide of copper, green; oxide of gold, a ruby red; oxide of antimony, orange yellow; uranium, a delicate greenish color very beautiful but costly; suboxide of copper, brilliant red, but renders the glass almost opaque, etc., etc. A dirty yellow may be given to glass by the admixture of soot or powdered charcoal. The beautiful Bohemian ruby glass is of very complex composition. It contains gold, peroxide of tin, peroxide of iron, oxide of lead, magnesia, lime, soda, potash, silica, and arsenic. Manganese gives a splendid amethystine tint to glass.

Some of these colors change after the glass is made. This is the case with the copper red, which at first is nearly colorless, but becomes red upon reheating after it is cooled. Blueish or greenish colored glass becomes by exposure to sunlight almost colorless from the combined effects of air and light. Glass containing lead is frequently affected by sulphureted hydrogen gas, becoming opaque upon its surface from the formation of sulphide of lead. The glass used by chemists is for the most part free from lead; the presence of the latter being in many cases a serious inconvenience.

M. Bontemps has shown that all the colors of the solar spectrum can be obtained by the use of oxide of iron in different proportions and by different degrees of heat. Similar conclusions have been arrived at in regard to the oxide of manganese. These differences of color are ascribed not to chemical combinations but to molecular conditions.

Most crystal glass is partially dissolved by boiling water, as it has a very large proportion of alkali. Glasses rich in alkalies have also a more powerful attraction for water than others.

The extent to which articles of glass now enter into domestic use, as well as certain branches of the arts, renders this material one of great interest and importance. Its peculiar nature gives rise to very peculiar methods of manufacture, which in the skill and taste required for their performance and the beauty of their product are unexcelled by any other department of industry.

The chief seat of the glass manufacture in the United States is Pittsburgh, which contains in the city proper and its immediate vicinity sixty-eight glassworks, making over half the glass consumed in the country. In a subsequent article we shall take our readers through some of these busy hives, and show them by what unique means and adroit operations some of the beautiful glass articles in common use are formed.

The Zirconia Light.

Messrs. Tessie du Motay & Co. have patented an invention for improvements in preparing zirconia, and the employment of the same to develop the light of oxyhydrogen flame. The specification is as follows: "Zirconia, or oxide of zirconium, in whatever manner it may be extracted from its ores, can be agglomerated by compression; for example, into sticks, disks, cylinders, or other forms suitable for being exposed to the flame of mixtures of oxygen and hydrogen without undergoing fusion or other alteration. Of all the known terrous oxides it is the only one which remains entirely unaltered when submitted to the action of a blowpipe fed by oxygen and hydrogen, or mixtures of oxygen with gaseous or liquid carbonated hydrogens. Zirconia is also, of all the terrous oxides, that which, when introduced into an oxhydrogen flame, develops the most intense and the most fixed light.

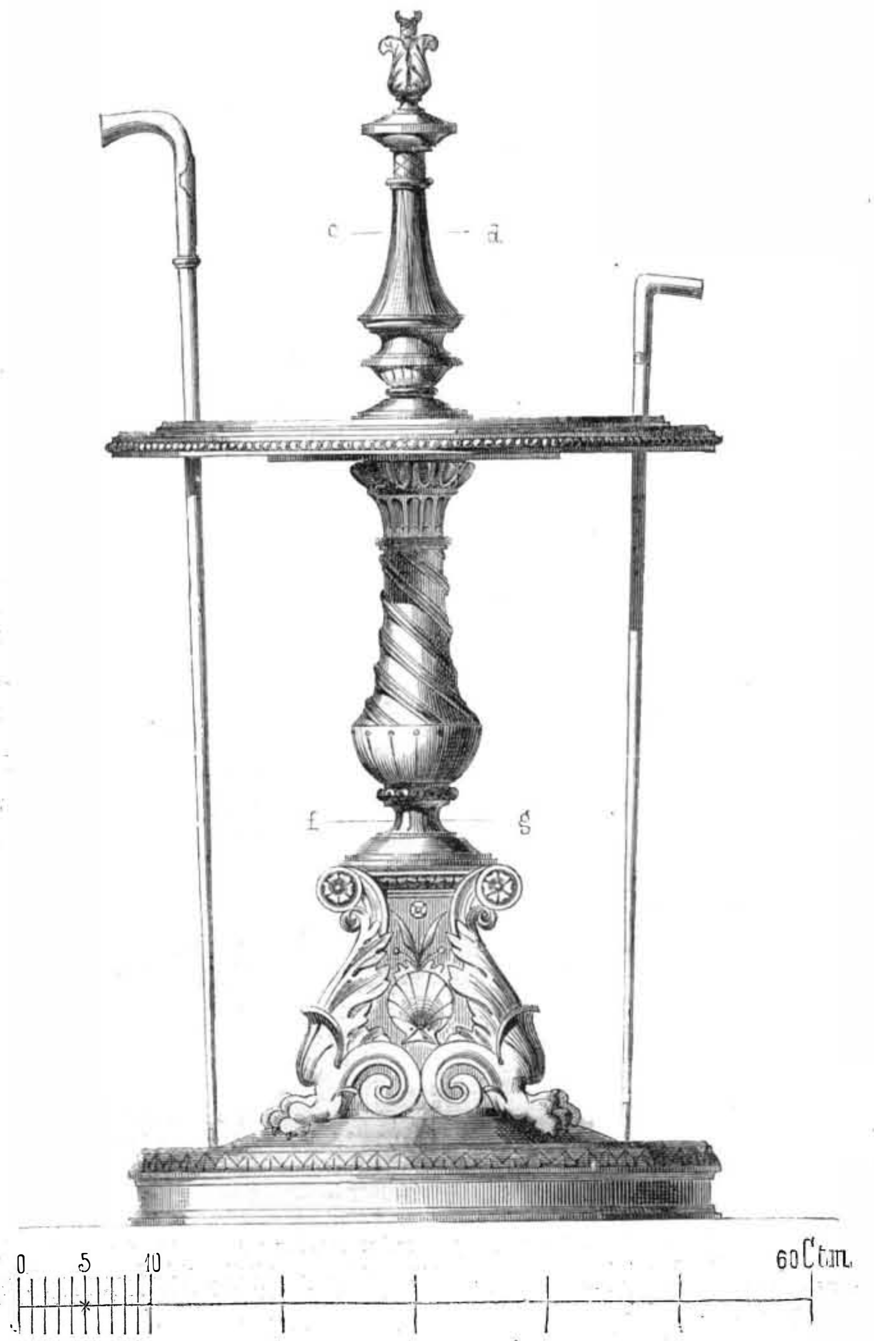
"To obtain zirconia in a commercial state I extract it from its native ores by transforming by the action of chlorine in the presence of coal or charcoal the silicate of zirconium into double chloride of zirconium and of silicium. The chloride of silicium, which is more volatile than the chloride of zirconium, is separated from the latter by the action of heat; the chloride of zirconium remaining is afterwards converted to the state of oxide by any of the methods now used in chemistry. The zirconia thus obtained is first calcined, then moistened, and submitted in molds to the action of a press with or without the intervention of agglutinant substances, such as borax, boracic acid, or clay. The sticks, cylinders, disks, or other forms thus agglomerated, are brought to a high temperature, and thus receive a kind of tempering or preparing, the effect of which is to increase their density and molecular compactness.

"I can also compress in molds shaped for the purpose a small quantity of zirconium capable of forming a cylinder or piece of little thickness, which may be united by compression in the same mold to other refractory earths, such as magnesia and clay. In this manner I obtain sticks or pieces of which the only part exposed to the action of the flame is of pure zirconia, while the remaining portion which serves as a support to it is composed of a cheap material.

"The property composed by zirconia of being at once the most infusible, the most unalterable, and the most luminous of all the chemical substances at present known when it is exposed to the action of an oxhydrogen flame, has never before been discovered, nor has its property of being capable of agglomeration and molding, either separately or mixed with a small portion of an agglutinant substance.—*Chemical News.*

Stick and Umbrella Stand.

We herewith reproduce from the *Workshop*, published by E. Steiger, 17 North William street, New York, the annexed



STICK AND UMBRELLA STAND.

unique and beautiful design for an umbrella stand, which speaks not only for itself but the excellent character of the publication.

LYCEUM OF NATURAL HISTORY.

This Society met at its rooms at the Mott Memorial Library on the evening of December 28th, and after the usual preliminary business, Dr. Schweitzer, of the School of Mines, stated that he had made a qualitative analysis of the green substance discovered by Mr. E. G. Squier in the Peruvian girl's dressing case. It contained silicate of lime with some alumina. He did not consider his investigation satisfactory, as owing to the small quantity given him, he was unable to make a quantitative analysis.

Professor Eggleston (in the chair) inquired what was the coloring matter. Was it of an organic nature?

Dr. Schweitzer—Undoubtedly so. The coloring matter was of a decided grayish blue, which on ignition turned white.

Dr. Feuchtwanger stated that near Rockwell, in Canada, he had met with specimens of phosphate of lime which when broken open showed crystals which contained a round hole. He asked for explanation as the phenomenon was extremely rare.

Professor Eggleston pointed out that this hole occurred at the conjunction of the crystals. He supposed it was caused by some accident in the course of formation.

A member stated that it had a geodic aspect.

Professor Joy said: It will be in the recollection of members that Professor Graham, Master of the Mint, discovered on May 16, 1867, the occlusion of hydrogen gas in meteoric iron. It would now appear that he had discovered a new metal, or rather had demonstrated the existence of a very old metal. In a letter to Professor Horsford that eminent scholar states that he is preparing a paper for the Royal Society on certain experiments of his with palladium, magnesium, and hydrogen, which have resulted in the discovery of what appears to him to be a white magnetic metal, hitherto unknown, with a specific gravity of 2. He thinks it is the metalic base of hydrogen. This, said Professor Joy, is a discovery of remarkable importance—one that the gentleman who prepares the cable telegrams for us would have announced at once had he sufficient knowledge of its interest. We must, however, now wait for further particulars until we find them in the proceedings of the Royal Society.

Professor Eggleston spoke briefly and emphatically of the importance of this discovery.

Professor Joy said—The regular subject for our discussion this evening is pisiculture, a study of comparatively recent date. It was in 1763 that a German named Jacobi first published in the *Magazine of Hanover* a paper on the subject. It did not, however, attract much attention, and his discovery appears to have been lost and practically forgotten. In 1840, or thereabout, a fisherman of the department of the Vosges, named Reme, entirely illiterate, discovered by his own observation, the art of artificially propagating fish. In 1843 the administration of that department took the matter up, and in its official journal, published in 1844, a report on the subject. It was not until 1848 that the French Institute took up the subject. In 1855 he had purchased at the French Exposition a guide to fish culture. Little progress had been made in the art hither o, so that in the year almost elapsed we are barely on its threshold. He asked Mr. Gilmore to state his experience on the subject.

Mr. Gilmore said that, interested as we all are in the study of natural history, it did not seem to him that sufficient attention has been paid to the fish. His observation had shown him that fish were most intelligent. When in Japan, he had seen in the fish pond of one of the American Vice-Consuls, fish that knew the Consul, and would approach him, while timorous of every one else. He knew this to be characteristic of tame carp he had seen in various parts of Europe. It struck him that the tunny—a fish well known in the Mediterranean for several thousand years—knew America before the *genus homo* did, at least before Europeans. It was well known that the tunny in the autumn season rushed up the Mediterranean in hordes like buffaloes to the Black Sea, whence after spawning they returned, and in the month of March were seen pouring through the straits of Gibraltar westward. They then disappeared, and it was stated by some—even by naturalists of position—that they remained inanimate at the bottom of the sea. Some time ago when coming across the Atlantic he was walking one night on deck with the captain of the steamer, who had called his attention to the fact that at certain seasons he met large shoals of tunny crossing the Atlantic. It did not surprise them, therefore, to find that in the month of September large numbers of tunny are found in the neighborhood of the Gulf of St. Lawrence and the coast of Labrador. Recurring to the subject of artificial fish propagation, he stated that it was known to the Chinese twelve hundred years ago, who made use of their large inland rivers to support their teeming population. About fifty years ago it was introduced into England. He thought that it made greater progress in America than in had in England. He had heard there of the exertions of Mr. Seth Greene of this country. Mr. Frank Buckland, formerly an officer of the army, and now her Majesty's Commissioner of Fisheries, had paid much attention to the subject. Mr. Gilmore then proceeded to describe the artificial culture of salmon and trout. It was well known that the salmon was migratory. The season of its migration varied according to the temperature of the water. They ascended the rivers early if the water was cold, and not until December if it were warm as in the South of England. They ascend the river with but one object, which is to deposit their ova. After overcoming all difficulties intervening, they ascend as near as possible to the head water of the rivers. The female then forms a deep furrow in the sand and deposits her ova. While doing this she guards them against all the other denizens of the waters. When she has accomplished her task, the male fish comes and deposits the milt which impregnates the eggs. Both then cover up the eggs with sand. Those anxious to propagate the fish artificially throw a net over the female when she comes to deposit the egg, and by bending her back slightly over a pannikin, the eggs are expressed. There are generally 1,000 eggs to every pound a salmon weighs. Suppose then in the case of a twenty-pound salmon but half the eggs are matured, what an immense amount of fish is produced by one salmon! After the ova are expressed the milt are obtained in the same manner from the male fish, by dropping it into the pannikin the ova are impregnated. They are then placed in boxes built with steps, which, however, are hollow and partially filled with sand. The water passes in through a pipe from the upper step. By the action of the water the fish are hatched. It sometimes takes one hundred and sixty days to hatch them. Salmon in their first form are ungainly, having depending from them a little bag. This after six weeks passes away, being used by the fish as its nutriment. Having grown quite lively, they are removed to ponds, care being taken not to allow fish of different ages to live together, for they are cannibals and devour those younger than themselves. After a time they are allowed to go down to the sea, and it is noticeable that salmon always return to the place where they were bred, making allowance, of course, for those that are destroyed. He had made an estimate of the value of artificial cultivation of trout and salmon, from observations made at tanks on the Tay and in Vermont. Ova sold $8 per 1,000. In pond No. 1 there were 10,000 fish fed daily by three quarts of curds. In pond No. 2 there were 8,000 fish of the second year fed upon six quarts of curds daily. In the third there are 7,000 fish fed upon twelve quarts of curds. The total return which these fish produced, was $4,350, and the net profit $3,644. From this he inferred that the cultivation of fish was well worthy of adoption.

Mr. Waterhouse Hawkins, in a response to a request from Professor Joy, added some particulars to what Captain Gilmore had stated. He wished that that gentleman had said something about the cultivation of the delicious fish called char. It was conducted in the same manner as that of trout and salmon. Some two years ago, while acting as the honorary secretary of the Acclimatization Society, in the absence of Mr. Buckland, he undertook to propagate some char. He received the ova from Windermere. They were in—some 30,000—admirable condition. He treated them as Mr. Gilmore had already described, but the gravel was boiled to remove all its inhabitants previous to being used in the troughs. The impregnated ova were removed to the ponds just before the pellicle burst, as soon as the eyes appeared. Mr. Hawkins then detailed his efforts to send some ova to the Duke of Argyll, and strongly impressed on the lyceum the value of pisciculture. In compliance with a request of Professor Joy, he explained, by means of the blackboard and one of his inimitable freehand sketches, the difference between the salmon, trout, and char.

Mr Gilmore at the suggestion of Mr. Hawkins, detailed the circumstances which led to his discovery of the char in this country. He had caught some magnificent fish in this country of striking appearance and luscious taste.

No other matter matter coming before the lyceum it adjourned.

A Coal Miner in the British Parliament.

Mr. Carter, alderman and coal merchant, is the liberal colleague of Mr. Baines in Leeds. The *European Mail* says he is a remarkable man and perhaps may astonish the House. He began life as a worker in a colliery, and by his own unaided ability has risen to be a merchant, alderman, and member of parliament. He has had but little school education, but from assiduously reading bluebooks he has got to be fairly instructed in politics. He is a fluent speaker, and is never at a loss for a word. He speaks with the real Yorkshire burr; has not an H in his vocabulary; and if any preceding speaker says anything with which he (Mr. Carter) cannot agree, he says "I am of the *contrairy* opinion." His manner is energetic, even forcible; and takes with the Leeds clothweavers. He is in politics a radical of the radicals—bold, defiant; denouncing the church, denouncing the state, the army, the navy—denouncing, indeed, everything. He is president of the Leeds branch of the Reform League, and is said to be the only member of that illustrious association returned to parliament.

Military Cart.

This is a cart which was designed by Mr. W. J. Addis, executive engineer to the Local Fund Works at Bombay, to meet the exigencies of the Abyssinian War, comprising many essential points, and differs from any existing construction. The wheels are formed of segmentary parts of wrought iron, circumferenced with wooden fellies, and tired in the usual manner. By this arrangement the shrinkage is reduced to a minimum, so that the wheels are better adapted for hot climates. Among other advantages, it is calculated to be more durable than the ordinary wooden wheel, and runs much easier. The nave is flush with the spoke and tire, thereby lessening the risk of collisions. The axles are two in number, nine inches in length, and work in two plummer blocks fixed in the frames of the cart, and are easily arranged in case of damage. Another palpable advantage is that the pole is so arranged as to admit of the cart being drawn back without the necessity of turning, while it can also be wholly withdrawn and passed through the center of the box in the body of the cart, which contains a tent, and it can also be used as a tent pole.

How to Preserve Sodium Untarnished.

Many teachers, particularly in our high schools, have sodium preserved in the usual way, under naphtha. But the beautiful metallic luster is not seen under these circumstances; and if the metal is taken out and a fresh cut made, this only shows the luster for an instant. By the following artifice the *metallic appearance of sodium may be permanently exhibited.* Take two test tubes, one a little smaller than the other, so as to slip into the latter without leaving much space between the two glass walls, put some carefully cleaned sodium in the wider tube insert the more narrow tube, having previously given a thin coating of beeswax to the upper part of this latter; then gently heat the whole on a sand bath. The sodium will fuse, and by a gentle pressure, the inner tube was pressed down, so as to force the fused metal over a large surface between the two tubes, while the air is totally excluded by the beeswax. I have kept sodium for more than six months in this way, and it is now as bright and brilliant, as when first put up.—*Prof. Gustavus Hinrichs.*

New Method of Mixing Mortar.

A correspondent from Syracuse, N. Y., sends us an account of an invention perfected in that city for mixing mortar, which is simply this: The lime is first slacked in a vat with water enough to make it to a paste, and allowed to retain its heat for about twenty-four hours—it is next run off into a second vat, from which it is pumped by a chain pump to a revolving cylinder that has a large quantity of spikes on the inside. As it flows from the cylinder, it passes through a sieve of ten meshes to the inch, and every particle that is used has to go through these very fine holes no larger than a pins' head. From this machine it falls into a large vat, from which it is pumped as required to a similar revolving machine called the mixing machine, into which it flows in a continuous stream, and sand, previously sifted, is added at the rate of about eighty bushels per hour. The mortar made in this way is said to be of a very superior quality.

INFLUENCE OF THE OXIDES OF CHROMIUM AND TITANIUM ON THE COMPOSITION OF PIG IRON.

BY AUG. A. AND S. DANA HAYES, ASSAYERS TO STATE OF MASSACHUSETTS.

Within the last four years we have been frequently employed in chemical investigations of the altered characters of some pig irons, which resulted apparently under the usual circumstances in the reduction of uniform ore.

In these cases the amount of carbon united with the iron had been diminished, without the introduction of other matter, in quantity sufficient to influence a change in this connection, and generally no variation in the composition of the ore was known or suspected. We had analyzed the ores in some of the beds in former years and regarded them as well adapted to the production of pig iron of good quality; but in pursuing the research we were convinced that the change in quality of iron could be traced to altered composition in the ore of part of the beds used for supplying the furnaces.

The correctness of this view was confirmed by our analyses of many iron ores, in some of which we found the oxides of chromium or titanium, existing where they were not indicated and connected with the ore in beds which have been considered as pure iron ores.

Both the oxide of chromium and oxide of titanium, seem to act in the furnace or the crucible in a way to withdraw a portion of the carbon, or prevent that true union of carbon with a portion of the iron, which constitutes gray pig iron, without the metals of these oxides really alloying with the iron and thus indicating the cause of change. We have analyzed samples of pig iron where the alloys of chromium or titanium existed in the pigs, and where the oxides accompanied the ores in the beds, but we were not prepared to find an influence exerted on the quality of the pig metal *without the refractory metals forming a part of the composition.*

The occurrence of oxide of manganese with iron ore is common, and titanium compounds are often found in both magnetic and brown iron ores, as insoluble substances, in small proportions, and these compounds combine with and are removed by the fluxes without injury to the pig metal. These compounds of titanium are the cause of the often superb blue color of the cinder, produced under varying conditions of glassy or stony character, and must be carefully distinguished from those we regard as more detrimental in their influence on the metal.

In a number of analyses of iron ores we had found both oxide of chromium and oxide of titanium in a state rendering them soluble in diluted acids, and in a condition to escape detection in the ordinary modes of analysis. Both magnetic and brown iron ores have been found to contain either oxide of chromium, or oxide of titanium in this soluble state. Among the samples from contiguous beds, this diversity in composition made by the presence of some oxide of chromium or oxide of titanium existed; and while the bulk of a bed of ore was pure, continuations of the bed, or associated ore, yielded notable weights of oxide of chromium or oxide of titanium in the different samples.

The suggestion we would make to the iron master in view of these facts is, the possibility of the quality of the pig metals in anomalous cases being greatly influenced by the admixture of some ore, containing the oxides of chromium or titanium, with the basis ore of good quality. This may take place by the main bed being crossed by veins of mixed ore, or by the workings passing into contiguous beds where one kind of ore is used. In other cases, where the iron master can gain the great advantage arising from mixing ores, one of the kinds may contain the contaminating oxides and injure the iron.

We subjoin some results of analyses showing the proportion of oxide of chromium to the metallic iron contained in the ores:

1st. Magnetic ore—iron, 49; oxide of chromium, 1·40. 2d. Hematite ore—iron, 42·47; oxide of chromium, 1·60. 3d. Brown Massive ore—iron, 54·32; oxide of chromium, 1·90. 4th. Same—iron, 46·70; oxide of chromium, 1·04.

More traces have been discovered in some cases, while in other instances a larger proportion of chromium formed an alloy with the iron produced from the ore.

"ARE PAINTED LIGHTNING RODS ANY PROTECTION?"

BY JOHN H. PATTERSON.

We do not believe that paint or rust totally destroys the conducting power of a lightning rod; only in proportion to the amount of impurities with which it is coated. There is, doubtless, a point beyond which a conductor will cease to be one, because the impurities upon it may be so great that it will possess no more facilities for conducting the fluid to the earth than the building itself. It would all depend upon the extent of the charge, and whether there was any tin or zinc spouting in connection with it. The very best scientific authority says that iron has 12° of conducting power, tin 14°, zinc 24°, and copper 92°. All admit that electricity will follow the best conductors only. If such is a fact it cannot be reasonably supposed that if such spouting was in contact with a perfect iron rod, that a charge of electricity would follow the main conductor to the earth. Would it not rather leave the iron rod and pass over the spouting? It certainly would if the theory alluded to is correct. Whether or not the lightning rod was painted, it is natural to suppose that combustion would ensue. The explosion might not be very great, and no serious damage might be done, and no lives lost, yet that does not refute the principle. Every few days we read of the freaks of lightning, and upon buildings, too, protected by iron rods. Why is this? Professor Douglass, of the University of Michigan, in an elaborate paper upon this subject says, that the design of a lightning rod is to prevent a stroke of lightning by silently relieving the positive atmosphere of its overcharge. This idea looks very reasonable, for Dr. Franklin said that explosions only occurred when conductors could not discharge it as fast as they received it. Now if a conductor cannot discharge the fluid there must be a cause for it. Either it is not large enough, is not perfectly applied, or it is coated with impurities. We know that an ordinary iron rod will conduct off an ordinary stroke of lightning, for it has been seen; but when an explosion occurs it cannot be stated which of the other two causes is the particular one unless the conductor is in direct contact with spouting of a superior conducting metal. Then the case is very clear. If it is in contact with such spouting, the idea that electricity follows the best conductors is correct. If the rod is insulated from both building and spouting, then the cause must be the impurities on the rod, be they paint or rust.

Lightning rods of a proper metal, copper, applied in a proper manner, are certainly a means of protection.

A recent writer quotes Professor Henry to prove that conductors should be brought in contact with the spouting on a building. This principle is certainly true respecting copper, but for the reasons given above, we hardly think it correct to expect electricity to leave a good conductor (the zinc spouting) for a poor one (an iron lightning rod), and we do not believe that Professor Henry desires to be so understood.

There can be no doubt but what the conducting power of a lightning rod is affected in proportion as it is coated with impurities of any character. If electricity, in its passage to the earth, passed into the conductor, there might be some reason to suppose that paint would not interfere with it; but when it has been demonstrated by scientific investigation that it resides only upon its exterior surface, we are not at a loss to understand why the surface of a lightning rod must be free from such impurities. That electricity does not enter into a conductor, we will refer to "Silliman's Natural Philosophy," page 540; "Olmsted's Philosophy," by Snell, page 327; and "Nichol's Cyclopedia of Physical Science," article—Electricity. In "Parker's Philosophy," page 280, we read: ". . . . and paint destroys the conducting power of a lightning rod."

We are aware that our ideas are at variance with one of the most distinguished scholars in the world—Professor Henry—and, of course, we do not think of setting aside his authority; but we have given them, and let them go for what they are worth. In this connection we refer to a letter from Professor Henry, of the Smithsonian institute, in which he says:

> The paint with which lightning rods are usually covered consists principally of carbon, and as this is, in itself, a good conductor, it could hardly interfere with the conducting power of the rod. Beside this, though the electricity tends to pass at the surface of a conductor, it in reality passes within the metal, as a wire which fully conducts a discharge from a battery, may be coated with non-conducting varnish or sealing wax.
>
> The office of a lightning rod is to protect a building from a discharge from the heavens. As a general thing its effect upon a distant cloud must be too small to silently discharge its redundant electricity, though in some rare instances it is possible that it may so reduce the intensity of the cloud as to prevent a discharge, when, without such reduction, a discharge would take place.

JOHN MACADAM---INVENTOR OF MACADAMIZED ROADS

BY JAMES PARTON.

Few persons are aware who ride over the excellent macadamized roads of the Central Park, that Mr. Macadam, the inventor of the roads which bear his name, was once a resident of New York, and probably often walked or rode over the fields and farms which then occupied the site of the park. Yet such was the fact. Though born and buried in Scotland, he lived for some years in New York; and, possibly, the horrid condition of American roads before the revolutionary war, may have first impressed upon his mind the urgent necessity there was for a better road system.

John Loudon Macadam was born in 1756, in Ayr county, Scotland, not far from the birthplace of Robert Burns. His family was ancient and highly respectable. When he was little more than an infant, one of his uncles, William Macadam, accompanied the British forces which came to America under Lord Loudoun, during the old French war, for the conquest of Canada. This William Macadam, it appears, had something to do with supplying the British army with provisions; and when the war was over, instead of returning to Europe, he settled in the city of New York, where he became a thriving merchant. When John Macadam was fourteen years of age, his father died, and the boy was sent to America to become a member of the family of his uncle William, who procured him a place in the counting-house of a friend.

This was in 1770, when New York was a quaint old place, half English, half Dutch, situated at the end of Manhattan Island; the residue of which was verdant with woods and farms, and adorned with the villas and mansions of the wealthier citizens. People who are only acquainted with Manhattan Island now, when its beautiful groves are gone, its commanding bluffs dug away, its surface excavated and excoriated for rail-