Scientific American.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

NO. 37 PARK ROW, NEW YORK.

O. D. MUNN. A. E. BEACH.

TERMS.

One copy, one year..... $3 00
One copy, six months..... 1 50
CLUB RATES { Ten copies, one year, each $2 50..... 25 00
{ Over ten copies, same rate, each..... 2 50

VOL. XXIX., No. 7 . . [NEW SERIES.] *Twenty-eighth Year.*

NEW YORK, SATURDAY, AUGUST 16, 1873.

Contents.

(Illustrated articles are marked with an asterisk.)

TRIUMPH OF AMERICAN HARVESTERS IN AUSTRIA—THE ENGLISH EXHIBITORS BACK OUT OF THE COMPETITION.

The result of the trials of the mowing and reaping machines, recently held at the Vienna Exposition, is a substantial and unequivocal triumph for the American inventions. We print elsewhere a full account of the experiments, extracted from the page of our English contemporary *Engineering*, a report which we have purposely selected in preference to many at hand from American correspondents, in order that our readers may have before them the acknowledgement of the victory as dictated by the most adversely prejudiced of all observers.

It will be noted that the tests were confined to American machines in a large majority—in fact, we might add, exclusively, for the German devices entered were merely German imitations of English copies of American originals. The British manufacturers were conspicuous by their absence, declining to compete for no reason that we are able to discover, other than that, after comparing their machines with those from this country, they considered their defeat a foregone conclusion. Their machines, presumably of the best types made, were entered for competition; and according to their own showing, the circumstances of the trials were particularly favorable for them. But in spite of all their facilities for improved construction, in spite of their much vaunted progress in agricultural machinery, and in spite of medals and honors innumerable, won in domestic expositions, the English makers have fairly and squarely backed down, and this on a simple inspection of the American exhibit.

Engineering makes an ineffectual attempt to gloss over the fact by disparaging the nature of the trial and consequently the ability of our machines to perform difficult work; but conveniently forgets that the same conditions were free to the devices of its own country. It seems to us that it would have been much more just and fair for the English exhibitors to have taken part in the ordeal, and sustained, if need be, an honorable defeat, rather than to permit the inferiority of their products to stand publicly confessed by a deliberate and cowardly withdrawn from the contests. The part taken by our contemporary in decrying an honestly won success is neither generous nor graceful, nor is the clumsy subterfuge of ignorance, manifestly advanced in order to avoid a candid admission of superior merit, one worthy of a journal supposed to be upright and unprejudiced in its opinions and dealings.

TOWING SAILING VESSELS.

"Suppose a tug tows a sailing vessel at the rate of three knots an hour: would the vessel be propelled at the same speed, if the engines and propeller of the tug were placed in her?" This is a question recently asked by one of our correspondents; and we propose to give the answer at greater length than would be convenient in the columns devoted to "Answers to Correspondents."

When a vessel moves through the water, it encounters resistance: 1st. The resistance of the midship section, which is influenced by the form of the bow lines, it being a well known fact that a wedge-shaped body is more easily forced through the water than a blunt ended one with the same immersed cross section. 2nd. The skin resistance, which depends upon the amount of immersed surface of the vessel. Both forms of resistance are also dependent upon the speed of the vessel, the resistance offered by the water to the vessel's passage varying about as the square of the velocity. It will be seen, then, that however the vessel is forced through the water, whether by power applied at the bow, such as the action of a tow rope, or by the motions of a wheel connected with itself, there is a definite amount of resistance to be overcome, to produce any given speed. If the vessel is being towed by a tug, the motive power must overcome the resistance of the tug, in addition to that of the vessel; so that, if the engine and propeller were removed from the tug to the vessel, the resistance to be overcome would be lessened by the amount offered by the tug. It does not follow, however, that the vessel would go faster than before, or even as fast, under these new conditions. The propeller works in a yielding medium, and does not utilize all the power imparted to it by the engines. Part of the power goes to propel the vessel, and part is expended on slip, which produces no useful effect. It is well known that the propeller must be adapted to a vessel; and it might happen that, in changing the machinery from the tug to the sailing vessel, we should give the latter a propeller that was not suitable; so that the slip of the wheel would be increased, and she would not go as fast as before, with the same expenditure of power. In general, the propeller would not be adapted to its new position, for there is ordinarily a great difference in the hulls of steamers and sailing vessels. Tug boats, as usually constructed, have another advantage over sailing vessels, in their capacity for utilizing the power imparted to their wheels. Our readers have doubtless noticed that the stern of a tug is constructed to overhang the immersed hull. The effect of this projection is to partially confine the water thrown up by the propeller in its revolution, thus creating a more solid medium for the action of the screw. The under part of the overhanging portion is also made in the form of an inclined plane, and the effect of the concussion of the water thrown up is to force the tug ahead. If the propeller were transferred to the sailing vessel, and given the same immersion as before, the loss of this overhanging portion would be perceived at once by the increased slip. We conclude, then, that, under the ordinary circumstances which occur in practice, the effect of changing the motive power and propeller to the sailing vessel would be to decrease the speed. It may be interesting to consider whether there are any conditions under which this transfer could be made to advantage.

Suppose the tug were secured behind the sailing vessel so as to form virtually an addition to the length of the latter: it is evident that it would propel the vessel quite as well as if it were in advance, and employed a tow rope. Now conceive the stem of the vessel to be cut down, so as to be exactly similar to the stem of the tug, and a transfer of machinery to be made. Then it is reasonable to assume that the propeller would be as effective as before, and that the vessel would now go somewhat faster, since the resistance to the motion of the tug would no longer be encountered.

We do not think that this matter has ever been investigated by actual experiment. We have endeavored to lay down clearly the principles governing the case so as to point to reasonable conclusions. As our readers know, however, stubborn facts have often overturned many finely constructed theories, which were defective on account of not noting all the data; and we do not claim to give an infallible opinion. The question under discussion has been often propounded, eliciting a variety of answers; and we have thought it well to treat the matter somewhat at length on account of the many interesting points involved in its consideration.

LIGHTNING RODS.

Perhaps one of the most fruitful sources of mischief is found in the practical application of imperfectly understood or incorrectly interpreted scientific theories. Inventors are not unfrequently misled by what they take to be scientific truths, because their understanding of them squares with some favorite idea. Take an illustration. Notwithstanding the reiterated statement, in the SCIENTIFIC AMERICAN and other exponents of practical science, that it is impossible to utilize water as a fuel, because it takes as much heat to decompose it into oxygen and hydrogen as one can get from the recombustion of these gases, men continue to waste their time in inventing apparatus to accomplish it. In other cases again, a misunderstanding of the principles involved may cause not only the waste of time and energy, but the destruction of life and property. The construction of lightning rods is a case in point. If the reader of the literature on the subject happens to find the experiments of Professor Henry and others, he will note their conclusion that electricity of high tension passes along the surface of bodies and not through their substance, and this will suggest to him to increase the surface of his lightning rods at the expense of their solidity, by making them hollow tubes of greater diameter. Or, perhaps, he will recollect that in all electrical measurements of conductivity, as for example in testing submarine cables or telegraph wires, the conducting power is in proportion to the thickness of the wire, and he will find it difficult to reconcile the two principles. The difference in the nature of the two kinds of electricity, however, will easily explain it. By means of an electrical machine we obtain a very small quantity of electricity at a time, but it is under great pressure; the moment it is delivered therefore, its self repellent nature causes it to fly off towards the surface of any conductor. This was the kind of electricity experimented upon by Professor Henry. On the other hand we have means for developing large quantities of electricity having very little tension or pressure, which will consequently flow quietly through a wire in a mass sufficiently great to permeate its whole substance. Professor Morton very aptly compares the former kind to the water in a hydraulic press; it is under enormous pressure, but extremely little is delivered at every stroke of the pump. The latter kind, on the other hand, would resemble a large mass of water, such as a river or a canal, slowly flowing along with so little "head" as to be incapable of breaking down the slightest obstacle or projection of its banks. Now of which kind is the electricity of a thunder cloud? Manifestly of both; it is there under high pressure, and at the same time a cloud, say a square mile in area, would contain a vast quantity. It follows from this that, although considerable surface is an advantage, it should not be obtained by a sacrifice of solidity.

In 1823, Gay Lussac presented a report to the French Academy of Sciences, in which the most advantageous manner of constructing lightning rods is described in detail. It is from this source, and from a subsequent report by Pouillet in 1854, that the text books on the subject have chiefly drawn their information. The following are the principal points of interest there stated and subsequently developed by experience:

The object being to make so good a passage for the lightning to the ground as to remove all danger of its leaping to some conductor in the house, the end of the rod should be sunk deep enough to reach moist soil. The greatest care must be taken not to have any break in the conductivity. As it is inconvenient to manufacture or transport the rods in one piece, the different parts must be in intimate connection when they are put up; it is best to have them soldered and the joints protected from the air and moisture.

If moist soil cannot be struck, the end of the rod should branch out in various directions to insure a speedy dissemination of the electricity in the ground. The material most generally used in constructing the rods is iron, but the point is best made of copper. Platina was at first recommended, because it is unaltered by the action of the atmosphere; but copper is so much better a conductor of electricity that it is now preferred. Whenever a thunderbolt struck a platina joint, it almost invariably melted it, while copper would mostly conduct the electricity so fast as to prevent melting. Its greater cheapness is, of course, another and not inconsiderable advantage. Sir W. Snow Harris, F. R. S., states that a copper rod of one inch in diameter, or an equal quantity of copper under any other form, will resist the effect of any discharge of lightning hitherto experienced. The reason for terminating lightning rods in a point is as follows: When a thunder cloud highly charged with positive electricity comes up, it repels the positive electricity of all bodies on the surface of the earth coming within its influence, and causes negative electricity to accumulate in them. This is called induction, and it always takes place before a discharge. Now, it has been discovered that, when electricity is accumulated in a body in this manner, it can most readily escape by sharp points because in them it meets with the least resistance. A lighted candle held near the prime conductor of an electrical machine furnished with a point will be nearly blown out by the current of air produced by the escape of the electricity. Lightning rods are therefore provided with sharp points to allow the accumulated negative fluid to pass off readily into the air and neutralize the positive fluid of the thunder cloud.

It was supposed by Charles and Gay Lussac that a lightning rod protected an area whose radius was double the hight of the rod extending above the building, but this rule is no longer reliable by reason of the extensive use of metals in the shape of pipes, etc., in the construction of the buildings of our day. When electricity finds several paths to the ground, it will prefer the best, it is true; but some portion will also pass along the poorer conductors. If, therefore, any metallic substances lie within the area supposed to be protected, they are in danger of being struck. This is especially true where the lightning has a chance to jump to the gas and water pipes of a building. It is a good plan to connect these pipes with the lightning rod; if the rod is struck, the electricity will then have an excellent path into the ground and will be rapidly diffused over the vast underground network of pipes. The danger to the inmates of the house of being struck from these pipes is less than that of receiving a shock from the powerful induced currents, liable to be developed in them, if unconnected, during a thunderstorm.

Houses constructed entirely of iron manifestly stand in no need of lightning rods at all, because the electric fluid, on striking so good a conductor, would rapidly diffuse itself in all directions and flow into the ground, provided, of course, that the construction of the building is such as to allow its free escape. If on the contrary any obstacles oppose the free passage of the electricity into the ground, such buildings become highly dangerous and utterly unsafe, for the storage of inflammable material, from the tendency of the lightning to leap across the interior of the rooms. Whenever, therefore, the iron portion of the building does not extend clear down into the ground, prudence would command the establishment of a sufficient ground connection on every side by means of metallic rods.

People are apt to be indifferent whether their houses and stores are provided with lightning rods or not, and are always ready to give an example where some building so provided was struck in spite of its protection. Such cases have undoubtedly occurred, and they are often quoted by the old fashioned "practical men" with much satisfaction, because they hail in them what they are pleased to call the victory of their sound common sense and the discomfiture of the scientific man. This class is, however, rapidly diminishing in numbers under the influence of the extensive diffusion of scientific education among the people by popular lectures and by the press. It may be well to assure unbelievers that the efficacy of the lightning rod is no longer an open question, and that any failures are attributable to bungling or ignorant construction. It would be an easy matter to multiply statistics in proof of the assertion; but none would carry with them more force than the following statement obtained from the records of the British navy:

Formerly the annual damage to ships by lightning involved an expense of $30,000 to $50,000. Between 1810 and 1825, no less than thirty-five sail of the line and thirty-five frigates and smaller vessels were completely disabled; and in 200 cases recorded, 300 seamen were either killed or injured. When the lightning rod was introduced, every mast was furnished with a capacious conductor permanently fixed and connected with bands of copper passing through the sides of the ship under the deck beams, and with large bolts leading through the keel and keelson, and including, by other connections, all the principal metallic masses employed in the construction of the hull (Harris). Since the adoption of this arrangement, "it appears that damage by lightning has positively vanished from the records of the navy." In one case, while the small frigate Conway was under refit in the harbor of Port Louis, the topgallant masts were down on the deck, and a small spar, not having a conductor, was substituted for the time to support the pennant. A thunderstorm came up and the spar was shivered to atoms. No further damage was done, however; for the conductor on the topmast below the spar immediately carried off the terrific flash. No further examples are needed to prove that a lightning rod, constructed according to the principles set forth, is a protector to life and property.

RECENT METEORIC INVESTIGATIONS.

On the tenth of the present month, the earth passed through the first of the two great rivers of meteors which intersect its orbit; and on November 13 or 14 it will encounter another shower of shooting stars, of equal magnitude. The band recently traversed, known in ancient times as the Tears of St. Lawrence, is about 10,948,000,000 miles in its greatest diameter, and 4,043,350 miles wide at the point of the earth's crossing.

Probably the most recent investigations into the nature of the erratic masses which constitute these vast belts are those made by Father Ferrari and others in the fall of last year, recently published in *Les Mondes*. They are based principally upon the observation of a remarkably brilliant aerolite, which fell near Orvinio, in Italy, during the latter part of August, 1872. The course of the body was from the southward and eastward, it appearing at first quite small and emitting a reddish light which gradually increased in brilliancy, leaving behind a misty train. Suddenly the bolide flamed up apparently as large as the moon, and then instantly disappeared, a long cloud, of serpentine form, remaining in its place. About three minutes after, a violent explosion was heard, followed by two others of less intensity. From the point of first observation to that of its disappearance, the meteor traveled over a trajectory of 62 miles, and its altitude at the beginning was measured at 30°, corresponding to an elevation of about 114 miles. The first detonation took place at a hight of 10·2 miles, and the final bursting into small fragments at a few hundred feet above the earth. The velocity of the mass was calculated at 32·2 miles per second.

In order to determine the amount of heat developed by the aerolite after entering our atmosphere, Schiapparelli's investigations were employed. That astronomer has demonstrated that, if a meteor enters the limits of the earth's atmosphere at a minimum velocity of 9·6 miles per second, when it has arrived at a point where the atmospheric pressure is at ·36 inch, it will have already lost $\frac{1}{11}$ of its velocity, and $\frac{13}{131}$ of its *vis viva*. It is evident, therefore, that so great a proportion of lost motion must be converted into enormous heat. Applying suitable formulæ to the case in point and assuming the specific heat of the body to be ·22 of 1° centigrade, which is not far from the truth, it has been found that the augmentation of temperature, after plunging into the earth's atmosphere, would be 3,468,107·8° Fahrenheit, a degree far more than sufficient to explain the phenomena of light and heat, as well as of the explosion or total dispersion of immense masses.

A number of fragments of the meteorite above referred to, quite small in every instance, were picked up and subjected to careful examination. The mass was crystalline, and formed of various substances. An angle was polished with difficulty, owing to the extreme hardness. An abundance of malleable granules of nickeliferous iron were recognized. The interior of the fragments appeared porous, but outside they were covered with a pellicle of vitrified matter. Beyond the iron above mentioned, the greater part of the mass contained soluble silicates, principally those of magnesium and of iron. From the fact that it has been noted that the meteors of the August and November showers, travelling at the rate of from 36 to 40 miles per second, find an insurmountable obstacle in the atmosphere, Schiapparelli has pointed out that only bodies of an enormous magnitude would be able to penetrate it and reach the surface of the earth in a fragmentary condition. Ferrari observes that, from this, it may be considered that the meteor he describes, having a velocity nearly equal to the above, must have been of tremendous size, and he notes, as a remarkable fact, that an unusual number of these bodies, ten in all, fell in Europe between July and September of last year.

The author states the result of his observations to accord with the following conclusions previously enunciated by Schiapparelli: 1. The intimate correlation between the comets, shooting stars, and meteorites is now placed beyond doubt, and the immense velocity observed in some meteorites renders it impossible to ascribe to them a planetary origin; consequently the hypothesis of stellar origin is the most probable. 2. From this supposition, the masses come from no single body, since divers cases demonstrate the fact that they arrive from totally different regions in stellar space. 3. The hypothesis admitted, it must follow that the chemical and molecular structure of the bodies of the universe, situated in different positions, must be of similar nature to that of the meteorites themselves.

The below given views regarding the mineralogical structure and composition of aerolites are ascribed to Danbrée, and are the results of examination both by spectral and chemical analysis: 1. Hundreds of analyses by the most eminent chemists prove that meteorites contain no simple body unknown to our globe. 2. There have been recognized with certainty twenty-two elements, given below in the descending order of their importance: Iron, magnesium, silicon, oxygen, nickel, cobalt, chromium, manganese, titanium, tin, copper, aluminum, potassium, sodium, calcium, arsenic, phosphorus, nitrogen, sulphur, chlorine, carbon, and hydrogen. It is a very curious fact that the three bodies which predominate in nearly every meteorite, iron, silicon, and oxygen, are also those which predominate in the earth. 3. Meteorites have also many peculiar mineral compounds, principally native nickeliferous iron, sulphide of iron and of nickel (schriebersite) and sulphide of iron (troilite). There are also common to the meteorites of the earth a great number of combinations, similar not only in chemical composition but even in crystalline form. 4. Meteorites indicate in a measure the temperature at their formation, and that by which they are caused to disaggregate. 5. Lastly, these bodies demonstrate the existence of innumerable masses disseminated through the remotest regions of space, which would be completely unknown were it not for their sudden and splendid apparitions.

LEAD POISONING AND ITS TREATMENT.

Cases of lead poisoning are becoming more frequent now than formerly because there are more persons engaged in manufacturing this metal, who are, more or less, surrounded and enveloped by a lead-poisoned atmosphere. In a metallic state lead enters into alloys; its salts are used in paints and dyes; it is a constituent of enamels and cements. Lead pipes conduct our drinking water; and the purer the water that flows through it, the more danger there is; while, if the water contain certain salts, they are deposited on the sides of the pipe and protect the water from the metal. Zinc vessels contain lead, and while in some countries the law limits the quantity of lead to ten per cent, even six per cent is fraught with danger to health. Horse hair and silk are dyed black with lead; the laces worn by ladies, as well as their cosmetics and hair dyes, contain lead. No doubt many cases of colic, whose origin seems shrouded in mystery, were caused by lead in the solder of metallic vessels or the glazing of stone ones. The foil used in wrapping tea and tobacco causes lead poisoning, and so do the granules of lead that are sometimes left in tin cans and jars. An old soldier has been known to suffer severely from using leaden shot; and the workmen in glass houses where lead salts are used are similarly troubled. Even type setters are occasionally poisoned by handling type made of an alloy of lead. Many other ways may be mentioned in which lead is introduced into the human system, but these must suffice for the present.

Whatever may be the cause of lead poisoning, it is certain that it is generally observed in summer when the heat favors the colic. Lead may be taken up by the digestive and the respiratory organs and through the skin, principally by the former, even in the case of insoluble salts, which probably dissolve in the gastric juices. Indeed some writers claim that cases produced by lung absorption are caused by salts deposited in the pharynx. The most striking symptom of lead poisoning is the peculiar color of the gums, and this is not due, as has been supposed, to the deposit of little particles of lead which are then acted upon by sulphureted hydrogen. It is rather one symptom of the general phenomenon, for it appears whether lead is taken inwardly or lead water is used on distant parts of the body.

Lead colic is usually preceded by indigestion. The size of the liver diminishes; and after the use of powerful cathartics, it becomes normal, and then contracts again. The nervous symptoms caused by lead poisoning are of several kinds, such as paralysis of the muscles, sleepiness, convulsions, blindness, and pain in the back bone; while on the other hand, insensibility and deafness may result. The skin on the back of the hands swells up as in gout. Albumen in urine is a most common occurrence, but the most striking symptom is *anæmia*, or lack of blood. Distention of the veins is frequently observed, and ulceration of the bones is not an infrequent consequence of lead poisoning.

While lead has so many ways of entering the system, there are very few ways for it to pass off. Little or no lead is secreted in the urine, except when it contains albumen, and there is very little lead in the perspiration. It seems that the metal is deposited where it is absorbed. When soluble lead salts are taken, an albuminate of the metal is formed; while insoluble salts, as before stated, settle upon the walls of the organs and are protected from absorption into the system. This explains the fact that lead workmen are sometimes attacked with colic long after they have abandoned their dangerous calling, the accumulated lead being very gradually dissolved and absorbed.

When lead produces indigestion, it is due to the lead's stopping the action of the digestive fluid. When digestion ceases, colic begins, which is the result of the local action of the lead upon the intestines, for it does not occur when absorption takes place in another way. The change of size in the liver is dependent upon changes in the vascular system. Just as far as this whole system comes under the influence of the poison, *anæmia* takes place, with chills, loss of elasticity in the arteries, and diminished capillary circulation. Pallor of the skin, contraction of the liver, and diminished quantity of urine are all referable to these causes. The asthma with lead poisoning is characterized by pain in the breast bone and difficulty of breathing, which, however, is not because the entrance of the air is obstructed, but because the blood does not come in contact with the air. Paralysis is one of the effects of a disturbance in the blood vessels.

In the treatment of lead patients, the pain must be relieved by the use of chloroform or chloral; opiates are to be avoided, as they produce constipation. The lead salts must be expelled from the digestive canal, and the constipation relieved; both these are best accomplished by drastic purgatives. The incrusted particles of lead, which remain attached to the walls of the intestines, must also be removed; and for this purpose, the use of sulphur is recommended, after purging, so as to convert the lead into the insoluble sulphide of lead, which can then be removed by cathartics. Insoluble lead salts, which still remain in the system, are best removed by administering iodide of potassium, which carries off the lead through the urine. Lead workers whose skin absorbs the poison should protect themselves by the use of salt baths. In France, Labarraque's solution (hypochlorite of potash) is used for this purpose; and to this should be added an excess of carbonate of soda. These baths are more useful than mere soap baths; and the bather, while in the water, must rub himself thoroughly. Instead of Labarraque's solution the following may be employed: 15 ounces chloride of lime, and 30 ounces crystallized carbonate of soda, dissolved in 10½ quarts of water.

The Permeability of Cast and Rolled Iron to Gases.

Both these kinds of iron are permeable to hydrogen and carbonic oxide gases. This is an important scientific fact, and the mode of penetration is a beautiful example of what the late Professor Graham named "occlusion," the mass absorbing the gas at one surface, transmitting it to the particles of the interior, and finally allowing it to escape into another gas, in contact with the other surface. This action differs from that of filtration essentially, and it takes place at a very high temperature only, when wrought iron is softened, cast iron changed in crystaline structure, and meteorolites are heated nearly to the point of fusion.

In all these cases, the iron mass retains several times its volume of hydrogen, carburetted hydrogen or carbonic oxide.

While, on one hand, this action corresponds to that where blister steel is formed, on the other it closely resembles the so-called alloying of palladium with hydrogen, the gas assuming a new physical condition.

The writer has learned that this interesting fact has been misunderstood so far as to lead to the belief that cast iron is porous when heated, and allows these gases to pass through castings; and in case of furnaces in use for heating dwellings, the hydrogen compounds and carbonic oxide, produced in imperfect combustion, pass through the iron and enter the air chamber, flowing with the heated air into apartments.

Such conclusions are wholly destitute of proof, as this action takes place, in carefully conducted experiments, only at very high temperatures, and involves molecular changes in the iron. It would now be novel and disheartening to learn that cast iron gas retorts, heated red hot for months and constantly containing carbonic oxide and hydrogen compounds, allowed the gas to pass through the metal even under pressure. Those who have had chemical experience with cast iron vessels highly heated, holding these gases, will not believe that iron has of late gained new properties. Those who use cast iron furnaces for warming may sleep quietly, if they are assured that all joints are tight.

A. A. H.

ELECTRO-DEPOSITION OF ALUMINUM.—John A. Jeançon, Newport, Kentucky, is the author of the following process: Dissolve the desired salt of aluminum or a double salt of aluminum and potassium, sodium, etc., in distilled water, and concentrate to 20° Baume, (at 50° Fahrenheit.) The battery used is either four pairs of Smee's zinco-platinum or three Bunsen's zinco-carbon, the elements connected for intensity. The solution is heated to 140° Fahrenheit, slightly acidulated, and a plate of aluminum is attached to the negative wire in working.

At Mont Clair, N. J., recently, the rods on a dwelling house were struck by lightning and the fluid passed off into the ground, thence upon a gas pipe near the terminal of the rod, to an air-gas carbonizer, located a short distance from the house. The gas apparatus was blown up, but no other damage was done.

OPERATIONS OF THE CANADIAN PATENT OFFICE.—From the 12th of February to the 8th of April, 1873, almost two months, one hundred and sixty-four patents were granted in Canada, of which eighty-five were issued to citizens of the United States.

Dr. TOBIAS' VENETIAN HORSE LINIMENT.—According to the analysis of Schaedler, published in the Berlin *Industrie Blätter*, a bottle of this celebrated liniment contains 1 ounce ammonia, half an ounce camphor, 1 ounce tincture of Spanish pepper, 7 ounces alcohol, 2 ounces water.

AT the close of 1872, there were in operation in the United States 67,104 miles of railroads, operated by 436 different companies. Average cost per mile, $55,116. Average dividends, 3·91 per cent.