jected to the action of powerful rollers which bring it to its finished shape. It is then too small in diameter for a locomotive wheel, and, after being heated, is placed upon an iron platform in the center of which is a segmented cylinder, which, by means of a hydraulic press, gradually stretches the tire to its proper size. It is not afterward turned, only cleaned, and the weldless steel tire is finished. M. Krupp also casts steel car wheels in solid disks, which require no turning after leaving the mold. England and her colonies ordered from his works, in 1865, 11,396 steel tires and 564 steel axles.

We have made this somewhat lengthy notice of M. Krupp's method of working steel to show that, with the proper machinery, the fabrication of the articles mentioned is entirely practicable. Indeed, we do not require to go to Prussia to prove this fact. The firm of Winslow, Griswold & Holly, at Troy, N. Y., are busily engaged in this manufacture. Their orders for steel rails, especially, are beyond their present means of production.

There can be no reason, at this late day, and in view of the experiments made in England and on the continent, for doubting the superior durability and the ultimate superior cheapness of steel rails and tires over those of iron. On our railroads it is theoretically correct to say that the weight of a load rests on a point, but it is not practically correct. There is compression. Much of it in the road itself, or the rail, but some of it in the wheel or tire. Yet notwithstanding that it can be demonstrated that this compression makes what would otherwise be a level road one continually up hill, there are persons who advocate a yielding foundation, as there are those who insist on a springing or yielding tire. The mere fact that our ordinary locomotive tires must be occasionally re-turned is a sufficient refutation of their position.

A perfectly rigid bed, or roadway, and as rigid wheels, is the rule that is found by experience to be the best. Soon as a wheel, or tire gets "out of round" it becomes, in operation, a hammer, destroying the rail. Mr. Bessemer at a recent meeting of the British Association at Nottingham, gave an exceedingly elaborate and interesting account of his own system of manufacturing steel, and showed the vast importance that branch of industry had assumed since his patent had come into working operation. By the old system forty pounds of steel was the largest mass of metal operated upon, but by his process as much as twenty-five tuns could be converted into steel in one heating. It had superseded iron wherever large castings were required—such as ordnance of large size, locomotive and marine engine cranks, rails, etc. He mentioned, as showing the superior durability of steel rails over those of iron, that at the station at Camden Town, at a part of the line over which all the traffic passed, a steel rail was placed on one side of the line and an iron rail on the other, and that seventeen faces of the iron were worn away while the first face of the steel rail was still in working order. Steel rails put down four years ago were still in working order. The first cost of steel rails was, of course, much greater than that of iron, but compensation was found for this in the greater durability.

The superintendent of one of our most successful railroads informs us that iron rails on that road average about seven or eight years of life. Steel rails have been recently introduced but the test is not considered sufficient to afford proper data for an opinion. Steel tires have been used on the road several years, some of them having already run 70,000 miles, and, while costing double the price of iron, their durability has proved that they are superior to iron ones. No such performance, we are certain, can be recorded for iron tires. The "best iron tires"—according to Thomas Prosser, C. E., who has lately issued a pamphlet on this subject, which should be a satisfactory exhibit to our railroad men—"average only 60,000 miles, during which time four of them will grind up one tun of rails."

It appears to be evident that our railroad companies will eventually save by replacing their iron rails, iron tires, iron wheels, and iron locomotive axles with those of steel, the rails to be laid on an unyielding and permanent foundation. Certainly, this subject of the comparative value of iron and steel for these purposes, is worthy more general attention than has been given it in this country, especially in the construction and "plant" of new lines of railways.

GAS PURIFICATION.

For some months past Mr. George Livesey has been testing, on a large scale, at the works of the South Metropolitan Gas Light Company, an important method, for which he has obtained a patent, of desulphurating the ammoniacal liquor, the object being to employ the ammoniacal liquor so purified for the purpose of removing the sulphureted hydrogen from the gas. It has long been known that caustic ammonia has a strong affinity for sulphureted hydrogen, and some years ago Mr. Laming attempted to utilize this fact by taking the foul ammoniacal liquor and passing it into a box containing oxide of iron, allowing it to stand for a short time, and then drawing it off free from sulphur. The liquor thus desulphurated was employed in a scrubber, and so far purified the gas that, on passing the latter through a vessel containing water only, it was found that the sulphureted hydrogen had been completely removed. Experiments with this process were tried at the South Metropolitan and at the Great Central Gas Works; but although the removal of the sulphureted hydrogen was, we believe, effected, the mode of purifying the ammoniacal liquor by the use of the oxide of iron was an inconvenient one, and the process, therefore, did not come into use.

According to Mr. Livesey's plan, the desulphurating of the liquor is effected by the aid of a portion of the waste gases taken from the chimney stack, the present method of proceeding at the South Metropolitan works being as follows:—A 5-inch pipe is inserted in the retort flue close to the chimney stack, and through this a portion of the waste gases are drawn away by the aid of an old exhauster, the 5-inch pipe being of such a length that, before the waste gases reach the exhauster they are cooled down. From the exhauster, the waste gases pass into a scrubber, 15 feet 6 inches in diameter and 24 feet high, filled with coke, where they are met by a descending stream of foul ammoniacal liquor distributed at the top in the ordinary manner by a couple of revolving perforated arms, or Barker's mill. The active agent in the desulphurating process is the carbonic acid of the waste gases, which displaces the sulphureted hydrogen in combination with the ammonia of the liquor, and thus in place of caustic ammonia a carbonate of ammonia is obtained, which experiments have proved to be quite as effective in absorbing sulphureted hydrogen from the gas as the caustic ammonia. We may mention here that the sulphureted hydrogen set free during the process of desulphuratting the liquor is conducted to the smoke stack and burnt, as its escape would otherwise constitute a nuisance in the neighborhood, but it is expected it will eventually be utilized.

The desulphurated ammoniacal liquor obtained from the bottom of the scrubber just mentioned is then pumped up into elevated tanks, from which it is led into other scrubbers, and employed for the purification of the gas. A scrubber of the size above mentioned has been found by experiment to be capable, under favorable circumstances, of desulphurating 640 gallons of foul ammoniacal liquor per hour; the average rate of working is, however, less than this, or about 550 gallons per hour. The quantity of waste gas required to effect the desulphurating of the liquor has not yet been ascertained precisely: but it has been calculated to be approximately about 2,000 cubic feet per hundred gallons purified. The liquor, after being used for effecting the purification of the gas, is again pumped into the foul liquor tank and re-desulphurated, and it can be used over and over again. It is found, however, that the liquor is slightly weakened by the desulphurating process, this weakening arising from the formation of a certain percentage of sulphite of ammonia, which, by the absorption of oxygen, is finally converted into the sulphate.

After numerous experiments, extending over a period of nine months, had been carried out on Mr. Livesey's process at the South Metropolitan works, a trial on the whole make of gas, amounting to 29,000 cubic feet per hour, took place on the 22d of May last. On that occasion two scrubbers, of the dimensions already given, were used with desulphurating liquor of barely five oz. strength, the first being supplied with 360 gallons and the second with 340 gallons per hour; and there was also a third scrubber worked with water, this being employed to remove the small proportion of ammonia carried over by the gas from the other scrubbers. The results of the trial were that the first scrubber removed between 70 and 80 per cent of the sulphureted hydrogen and about 20 per cent of the carbonic acid from the gas, and on the latter leaving the third scrubber, it was quite free from both sulphureted hydrogen and ammonia, and had given up half of its carbonic acid. The experiment was continued as long as the supply of the desulphurated liquor lasted.

On the 31st of May a more extended trial was commenced, this continuing until the 30th of June, and the make of gas during that time being 18,300,000 cubic feet, or 610,000 cubic feet per day. During this series of experiments one scrubber was used for effecting the desulphurating of the liquor, so as to keep up the supply, and the gas was acted upon by two scrubbers, one worked with the purified liquor and the other with water, the gas after leaving the scrubbers being conducted to the ordinary oxide purifiers as usual. Before the experiments were commenced, the oxide purifiers were "going off" or becoming foul at the rate of about once per week; but after the gas was subjected to the action of the desulphurated liquor only one purifier "went off" during the whole trial, and that not until the end of June. On the 31st of May box No. 2 stained the lead paper, and it was not until June 30th that No. 3 did the same, and this notwithstanding that the "liquor process" was stopped one day through a leaky valve, and on another through the pump getting out of order in the night, making a period of quite twelve hours during which the gas went direct to the oxide purifiers. The single scrubber worked with the desulphurated liquor was supplied with about 400 gallons of the latter per hour, and it was found that it removed 75 per cent of the sulphureted hydrogen and about half the carbonic acid. The bisulphide of carbon and other sulphur compounds were formed by Dr. Letheby's test, on an average taken from a number of experiments, to be reduced to 36 per cent below their amount when the purified liquor was not employed.

At present the plant at the South Metropolitan works does not allow of the process above described being applied to effect the purification of the whole of the gas made; but Mr. Livesey is, however, now erecting two large scrubbers for the desulphurating of the liquor, and is making other preparations for applying the process more completely. We should state, however, that, even when the new apparatus is completed, and the liquor system of purifying in full action, Mr. Livesey does not contemplate the entire disuse of the oxide of iron purifiers, but intends always to pass the gas through one or two boxes containing the oxide, so that in case of any accident hapening to the scrubbers the oxide would come into action and prevent foul gas from being sent out. The scrubbers for desulphurating the foul liquor are being built of brick, and they will each be 17 feet 6 inches in diameter inside and 20 feet high. Beneath them are large tanks, the one capable of holding 18,000 and the other 30,000 gallons of liquor. When the new brick scrubbers are completed, the three scrubbers, 15 feet 6 inches in diameter and 24 feet high, which are now used both for desulphurating the liquor and purifying the gas, will be required for the latter purpose only, and a fourth scrubber of the same dimensions, which is now being completed, will shortly be available for the same purpose. Under the new arrangements the waste gases will be led from the flue through a 12-inch main instead of by a 5-inch pipe, as at present, and it is probable that a condenser of the kind ordinarily used will be placed on the line of the main, so as to effect more thoroughly the cooling of the gases before they reach the exhauster.

At first the liquor was delivered by the pumps directly to the scrubbers; but now an elevated tank has been erected into which the pumps deliver, and from which the supply for the scrubbers is drawn. The tank is divided into four divisions, one being for the foul liquor which is to be desulphurated, and

the other three being intended for the reception of the purified liquor to be supplied to the scrubbers in which the gas is purified. It was supposed at first that there might be some deposition of tar in the pipes leading from these tanks or divisions, and the pipes were therefore led into another similarly divided tank sunk in the ground, other pipes leading from the divisions of this tank to the scrubbers. The sunk tank was intended to receive any tar which might drain down; but it has proved to be quite unnecessary, and has, indeed, occasioned some trouble from leakage taking place through the divisions separating the compartments.—*Mechanics' Magazine.*

Separating Phosphorus from Metals.

It is well known that phosphorus is a substance which prevents the production of pure qualities of iron and other metals, and all attempts to remove the same have hitherto failed. Mr. Carl H. L. Wintzer, of Hanover, has found that chlorine gas and chloride of calcium are adapted to obtain the desired result. Chlorine gas, as a simple element, does not decompose, and chloride of calcium is the only combination thereof which, at the different degrees of temperature which occur in practical metallurgy, neither volatilizes nor decomposes unless another agent be introduced. Other known combinations of chlorine, as chloride of magnesium, decompose even at the boiling point of water; chloride of sodium becomes volatile at a comparatively low temperature.

Mr. Wintzer therefore employs chlorine gas and chloride of calcium for the removal of phosphorus, in processes of melting ores and in the treatment of metallurgical products. He makes use of this gas and the salt in blast furnaces, as well as in the process of puddling, refining, and recasting, and in any kind of furnace and in all processes of melting, applying the gas direct or adding the prepared salt (chloride of calcium) in any convenient form; or employing solutions containing muriatic acid, with the simultaneous use of lime or calcareous substances, by which process chloride of calcium is formed at the moment of its application. Through the effect of chlorine gas and chloride of calcium on phosphatic ores and metals, volatile combinations of phosphorus are formed and thereby the phosphorus is removed. The process is as follows:—In smelting an ore of iron or other metal containing phosphorus as an impurity, the operator charges into the smelting furnace with the ore, chloride of calcium in the proportion of from five to twenty-five parts by weight for each part of phosphorus found by analysis to be contained in the ore, and in other respects the smelting operation is conducted in the ordinary manner. The resulting metal will be found much more free from phosphorus than if the ore had been smelted without the addition of chloride of calcium. In place of adding the chloride of calcium direct, lime and muriatic acid may be mixed separately with the ore, or may be otherwise applied in combination. It is more convenient, however, to employ chloride of calcium ready formed. Or, in place of employing chloride of calcium, chlorine gas may be used; the gas may be mixed with air and forced as a blast through the ignited charge in the furnace, or the gas itself may be blown through the melted metal after it is tapped out of the furnace. The quantity of chlorine thus applied should be from three to fifteen times the weight of the phosphorus contained in the ore or metal. Chloride of calcium or chlorine may be applied in a similar manner when remelting iron or other metals, when it is desired to separate phosphorus therefrom. Phosphorus can thus be separated from all metals to which a strong red heat can conveniently be applied; more especially, however, it is applicable to the treatment of iron and copper.—*Mechanics' Magazine.*

Punched Tubes and Gun Barrels.

The manufacture of punched steel tubes and gun barrels by Messrs. Deakin & Johnson's process, is likely to become a most important industry. The principal gun-barrel makers of Birmingham are now advertising that they are prepared to make fifteen thousand of these gun barrels weekly, and Messrs. John Brown & Co., of Sheffield, have nearly completed the erection of very heavy machinery for rolling the tubes, after punching, into barrels and jackets, for 7-inch rifled cannon. It is but a short time since even the most enterprising steel masters believed it to be impossible to punch a 10-inch hole down through an ingot two feet six inches in diameter and four feet high; yet this has already been accomplished, while, as for gun barrels, a single tube, of dimensions sufficient for the manufacture of four regulation barrels, is punched almost at a blow. The material employed is Bessemer steel, and it is indeed a question whether any other steel would permit of this mode of manufacture. With the least imperfection of the ingot, it cracks open or flies to pieces under the punch, and thus only perfect material can pass. As to the endurance of barrels made by this process, one test made at Birmingham, some time since, showed that a barrel of the Enfield pattern, punched from Bessemer steel, withstood, without injury, single charges of sixteen drams of powder and twenty-five Enfield bullets. The latter were forced into a continuous bar of solid lead when fired, yet the bore of the barrel remained intact.

The best gun barrels are now made of Marshall's iron, which is sold in skelps about 8 inches long, 5½ wide, and ⅝-inch thick, at, we believe, £28 per tun. Bored and ground and with the "lump" forged on, these barrels go into the gun trade at a cost of about 10s. 6d. each. Yet from "greys," "reins," or other faults, from sixty to seventy, and sometimes even two hundred out of every thousand, are rejected at proof. With the new punched steel barrels, which are at least one half better than iron, and which can be profitably made at the same price, there are no defects whatever in the metal, since no defective ingot will withstand the punch. Messrs. Deakin & Johnson's process is equally adapted to the manufacture of hollow steel shafts for marine engines, railway axles, etc. A hollow axle thus punched and rolled, and 5½ inches in external diameter, has been tested upon three-feet supports, by a weight of 16 cwt. falling 25 feet, the blows beginning, however, with a 5-foot fall, rising progressively 5 feet at each blow. Under the highest fall, the axle was finally deflected 7½ inches, but no sign of fracture was shown.—*Engineering.*

MISCELLANEOUS SUMMARY.

IT is stated, with how much truth we are unable to say, that an Austrian chemist, M. Leinelbrock, has discovered a method of inclosing electricity in small glass capsules which will explode under the influence of the slightest shock. The capsule, for the purposes of a projectile, is inclosed in a steel case, shot from a rifle, and when stopped by the body of a man will explode with sufficient force to kill. The statement appears to be somewhat "fishy." One would suppose that the shock of driving the projectile from a gun would be greater than that of being brought to a rest by the flesh of an animal. If the explosion took place anywhere it should be in the gun barrel.

A PRACTICAL saw maker of San Francisco has solved the difficulty of sawing a section of the big tree in Calaveras county to send to the Paris Exhibition. By his plan, two cuts are to be made on the tree, three feet apart, as deep as the saw will allow; the wood between the cuts being split out by wedges, angles are left which can be sawed and wedged as before. By the labor of two men the section can be ready for transportation within a month's time. The whole expense need not exceed five hundred dollars.

THE cost of living in New York at the present time is almost incredible, and it is astonishing where all the money comes from to support such extravagance. Furnished houses in fashionable avenues rent for $1,000 per month. A family living at one of our large hotels pay $700 per week for rooms and board. The average price for large rooms and board in the principal hotels cannot be less than $150 per week.

THE manufacture of the wire for the Atlantic cable kept two hundred and fifty hands employed for eleven months, supplying over thirty thousand miles.

To fix labels on tin, use French polish, or a solution of shellac in naphtha or alcohol.

THE *Journal of Applied Chemistry* gives the following recipes in reply to correspondents:—

To detect copper in pickles, put some of the pickle, cut small, into a vial with 2 or 3 drs. of liquid ammonia, diluted with one-half the quantity of water. Shake the vial; when, if the most minute portion of copper be present, the liquid will assume a fine blue color. Or immerse a polished knife blade; the copper will deposit upon it.

To remove fruit stains from napkins, etc., let the spotted part of the cloth imbibe a little water without dipping, and hold the part over a lighted common brimstone match at a proper distance. The sulphurous acid gas which is discharged soon causes the spots to disappear. Or, wet the spot with chlorine water.

THE big Horsfall gun, which was built at the Mersey Steel and Iron Works in 1856, and presented to the British Government, is to be mounted at Tilbury Fort, to command the mouth of the Thames. It was a solid forging of wrought-iron, bored out. The dimensions are: length, 15 feet 10 inches; diameter at the breech, 3 feet 7 inches; diameter of bore, 13·014 inches; weight, 53,846 pounds. The trunnions are forged on a separate ring, which is secured to the gun by a key.

COLT'S Works in Hartford, Conn., have contracted with the Government for the manufacture of one hundred of the Gatling guns. This gun is made of two sizes, one about that of the ordinary rifled firearm, and the other carrying a ball about one pound in weight. It is a revolving piece of six barrels, and proved in the late Government experiments to be the most destructive engine of war at moderate ranges hitherto employed.

WE have always maintained that the taxation necessary to pay the current expenses of the Government and the interest of the public debt should be raised upon articles of luxury, and that all necessary articles of consumption should be exempt so far as possible. Hence we are pleased to chronicle the fact that a large tobacco establishment of this city paid the enormous tax of $1,200,000 on their business during the past year.

PROF. PLAYFAIR, at the meeting of the British Association, stated that at the Riddings Colliery, there was a furnace 40 or 50 years old, the walls of which he found to be lined with plumbago three or four inches thick, which he attributed to the operation of the heat on the iron, but could not fully explain the mystery.

AN express train carried the twenty millions of thalers which form the war indemnity Austria must pay Prussia. The whole amount was paid in silver. It was loaded by the tun and took twenty men six days to count it. Ten clerks, twelve tellers, and thirty-six gendarmes accompanied the train.

THOMPSON'S CONNECTING LINK.—In No. 9, on page 142, current volume, is an engraving of Thompson's Link, the description of which speaks of it as cast iron instead of malleable iron. These links are made of malleable cast iron or forged wrought iron.

SIR ISAAC NEWTON is said to have worn in his finger ring a loadstone weighing three grains, and capable of sustaining over two hundred and fifty times its own weight.

A NOVEL anchor was lately tested in Baltimore harbor, triangular in shape, having six flukes, working on pivots, and when one side is imbedded the upper part closes, thus, it is claimed, preventing fouling.

THERE are 137,000 persons in Brooklyn who do business in New York. The difference between the number of people that reside in New York, and those doing business there, is 197,000.

A LETTER received in Boston says, Monsignon Columbo, the only living descendant of Christopher Columbus, intends visiting America next year.

THE quantity of glass necessary for the Exhibition Palace, in Paris, would cover twenty acres.

A PILL-BOX factory of Bristol, Vt., uses three hundred cords of birch wood per annum.

BLACK tea of fine quality flourishes remarkably well on the coast of Georgia.

SPECIMENS of salt from the Salt Mountains, in Nevada, have been received in Washington.