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Improvement in Cotton and Hay Presses.

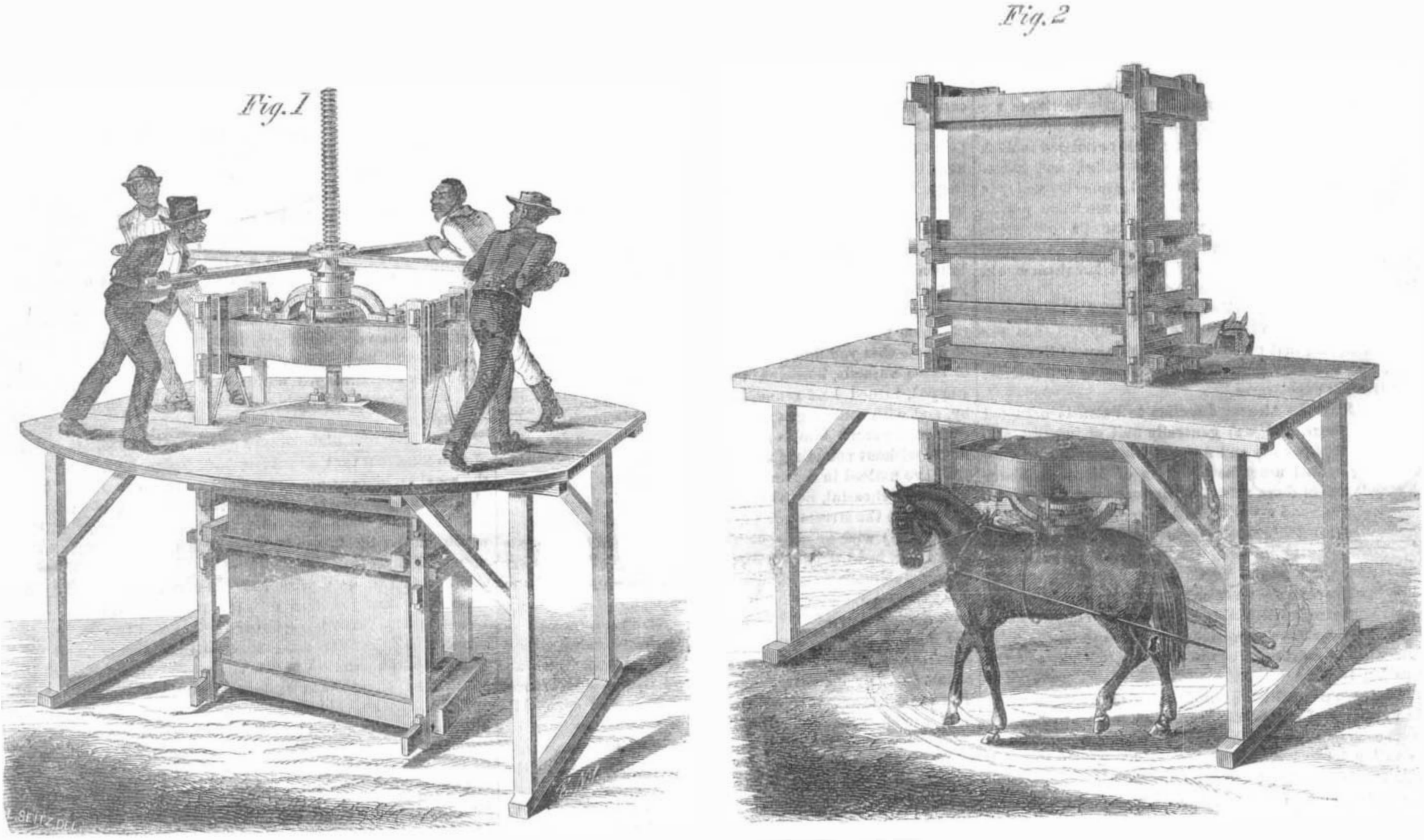
Some screw presses are so constructed that the operating arms, being fixed to the screw, rise and fall as the press is worked. This is a serious objection, as the operating power, whether men or horses, must be adapted to this change of level.

The engravings present views of a simple press adapted for cotton, hay, or other fibrous products requiring compression or baling. One of the engravings represents the press as adapted to man power, and the other as arranged for horse power, the change being effected simply by an inversion of the apparatus. This change can be effected in a few minutes. The platform sustaining the press is used, whether the machine is operated by hand, or by animal power. Its construction is evident from the engravings. It may be made in sections, so as to allow of being taken to pieces either for facility in transportation when desirable, or for changing the machine from a hand apparatus to one worked by animal power. The posts of the frame supporting the platform may be of wrought iron, connected together by cross beams, and properly braced. A floor may be fixed to the lower cross beams, when the apparatus is to be operated by manual power, and on this floor the packing tube or press may rest.

A strong beam passes across the operating end of the box, or packer, and to this is attached a yoke or arch of iron, or other metal, which sustains the nut of the screw, the friction disk, and the hub of the operating arms. The screw passes through the beam and the rings. Inside the metallic yoke is a cup disk surrounding the screw, and holding between it and the yoke a number of balls, intended to reduce friction. On the other side of the yoke is the double hub for receiving the operating arms. This hub is made in two parts, the disks being bolted together. Inside this hub is the nut for the screw. On that end of the screw which works in the compressing box is a piston which fits loosely the box and compresses the cotton or hay, its surface, as also that of the receiving end of the box, being scored across for the reception of the bands for securing the bale. That portion of the compressor furthest from the arms has the sides of the box removable for the reception of the material to be pressed.

This machine is simple in construction, easy in operation, and presents the advantage of being driven either by hand or by horse power. Patented through the Scientific American Patent Agency, Sept. 3d, 1867, by J. S. Schofield, Macon, Ga.

The rights for all States except Georgia are for sale by the patentee.



SCHOFIELD'S PATENT COTTON PRESS.

Silvering Glass Mirrors.

The process we propose to describe has for its author Prof. Henry Draper, of this city, and may be divided into five operations, viz., the cleaning of the glass, the preparation of the silvering solution, the warming of the glass, the process of silvering, and the polishing. The description is for a 15½ inch mirror.

1. Rub the glass plate thoroughly with aquafortis, and then wash it with plenty of water and set it on edge on filtering paper to dry; then cover it with a mixture of alcohol and prepared chalk and rub it in succession with cotton flannel.

2. Dissolve 560 grains of Rochelle salt (tartrate of soda and potassa) in 2 or 3 ounces of water and filter; dissolve 800 grains of nitrate of silver in 4 ounces of water. Take an ounce of strong ammonia of commerce and add nitrate solution to it until a brown precipitate remains undissolved. Then add more ammonia and again nitrate of silver solution. This alternate addition is to be carefully continued until the silver solution is exhausted, when some of the brown precipitate should remain in suspension. Filter. Just before using, mix the Rochelle salt and add water enough to make 22 ounces. The vessel in which the silvering is to be performed should be a circular dish of ordinary tin plate and coated with a mixture of equal parts of beeswax and rosin. At opposite ends of one diameter two narrow pieces of wood are cemented to keep the face of the mirror from the bottom of the vessel.

3. The glass is slightly warmed by putting it in a tub or other suitable vessel and pouring in tepid water to cover the glass; then hot water is gradually stirred in.

4. Carry the glass in the silvering vessel, into which the silvering solution has been poured, place the whole apparatus before the window and keep up a slow rocking motion. Leave the mirror 20 minutes in the liquid or half an hour, and wash with plenty of water.

5. When the mirror is perfectly dry, take a piece of the softest buckskin, stuff it with cotton, and go gently over the whole silver surface to condense the silver. You may use some of the finest rouge. The best stroke is a motion in small circles; rub an hour. The thickness of the silver thus obtained is about $\frac{1}{200000}$ of an inch.

Vegetable Soap.

There are certain plants distributed all over the world yielding a saponaceous juice which, to those who are desirous of having a white, delicate skin, must be far preferable to the finest "ambrosial," "milleflower," or "basket of fruit" soap. No doubt the ancients used such plants instead of soap; perhaps they were the same still used for the like purpose in Italy and other neighboring countries. Pliny, in giving the description of one of them, says:—"It grows on a rocky soil and on the mountains, and its leaves are prickly like those of the thistle." If this is the *gypsophila struthium* of Linnée, a plant still used for washing in the southern parts of Italy and Spain, and for which the description corresponds remarkably well, we must leave the botanists to decide. Suffice to say that besides this, the soap root of Europe, the aloe of Jamaica, the soap tree from the coast of Coromandel, and the horse chestnut, yield said juice, some by their leaves, others by their roots. Its peculiar principle—as chemistry teaches us—is the saponin, a body belonging to that class of organic substances which, upon being treated with certain acids or alkalies, yield glucose or starch sugar among their products of decomposition. The saponin is in its pure state a white solid, of a sweet but acrid aftertaste, it leaves, when spread over a plate, a fine looking varnish, but the most peculiar property is the viscosity of its solutions; when they contain camphor or resin, they will bear the heavy mercury.

Correspondence.

The Editors are not responsible for the opinions expressed by their correspondents.

EDITORIAL CORRESPONDENCE.

Annoyances of Spanish Travel—Valencia, Its Huerta, People, Curious Sights—Old Tarragona by Moonlight—Ancient Churches—Barcelona, etc.

MARSEILLES, Dec. 31, 1867.

A trip from Northern Spain may not inaptly be compared to entering a large animal trap. It is quite easy to get in but it is not so easy to get out unless the tourist is content to do nearly the whole thing over again. From Bayonne to the Mediterranean stops can be made at several stupid but interesting places, which break up the monotony of the trip; but there are no completed lines of railway along the sea, therefore the choice lies between poor coasting steamers or a return over the railway as far back as the junction at Alcazar, a station a few hours south from Madrid where another line branches off to Carthagena, Alcante, and Valencia

We left Malaga for Valencia at six in the morning, and returned to Cordova where we took another train northward to the Alcazar Junction which we reached at two hours past midnight—nearly an hour behind time. Here we found the Valencia train in waiting, and as it was necessary to purchase tickets and get our luggage weighed and changed there was no time to be lost, and what added to the peril of our situation the agent refused to take French gold, the first instance of the kind we have met since we commenced our travels on the continent in June last. What were we to do in such a dilemma? We had not quite money enough to pay our baggage and buy our tickets to Valencia. It was cold midnight; no bankers, no hotels, no nothing except Spanish insolence accompanied by a downright refusal to take some forty francs in gold simply because it chanced to have been coined in Paris instead of Madrid. Very fortunately for us a Frenchman standing near saw the fix we were in and true to his native instincts he relieved our situation by exchanging money which enabled us to pursue our journey as comfortably as we could on a cold, windy night in a slow Spanish train. But for this providential interposition there is no knowing exactly how we should have contrived to stop long at Alcazar or to have got away from that desolate place. The rural hotels in Spain are not intended to accommodate any body and nothing seems to surprise the proprietor more than to have a foreigner apply for lodging. The houses have no fireplaces, but warmth is supplied by the use of an old-fashioned brazier, which resembles a huge warming pan, into which burning charcoal and ashes are placed. Between the horrid diet and the fumes of the brazier if the guest succeeds in escaping with his life he may consider himself a special favorite of a kind Providence.

The railways in Spain are usually very expensive works as owing to the mountainous character of the country there is much deep cutting, tunneling, and heavy grading. The cars are divided into three classes, very similar, though generally much inferior to the French. The first-class cars are supplied with cylindrical-shaped vessels, covered with carpet and filled with hot water, which serve the most excellent purpose of keeping the feet warm. The cars are usually dirty, a national habit, scrupulously observed. The management of railways in Spain is more slipshod than in any other country, always excepting our own, with this great advantage in favor of Spain. All the highways and most frequented mule paths that cross the track are carefully guarded during the passage of the trains, a precaution not so necessary here as in our own country, for the reason that few carriages are ever seen on the common roads. To tell even a Spaniard that railway trains in the United States are permitted to dash headlong through towns, villages, and cities, and across highways, so regardless of life, limb and property, and you astonish him greatly. One of them said to me "you permit such things in your country and yet you boast of a civilization superior to our own. I do not believe it would be allowed even in Africa. The instincts of self-preservation alone would require some necessary precaution."

Throughout all Europe railway companies are compelled to pay strict attention to the lives of the people, hence the excellent discipline that marks the management of European railways, and the very general feeling of safety and comfort which a traveler experiences.

The route from the Alcazar Junction to Valencia occupied about twelve hours, and was generally dull of interest, and through realms of poverty and apparent barrenness until we passed a long tunnel near the old town of Montesa, above which stands one of those ruined castles once the safe retreat of robber knights who came down like vultures upon their defenceless prey. The scenery now changes to a valley of oriental beauty and exotic vegetation, abounding in orange, mulberry and palm groves which grow in wild luxuriance. The hillsides are terraced up in masonry for the purposes of irrigation and the fertile valley is watered by countless rills and conduits, the same as the Moors arranged them centuries ago, the whole constituting a most skillful application of the hydropathic treatment.

The Water Tribunal of Valencia sits once every week within the porch of the old Cathedral and applies to this day the same code of laws which were introduced by the Moors.

The valley lying back of Valencia is called the "Huerta" and offers one of the most beautiful and glowing pictures of fertility to be found in Europe, the sight of which almost compelled us to overlook all the shortcomings of decripit old Spain

So far as mere sight seeing is concerned, Valencia cannot detain a traveler very long. It is a thriving city of over one hundred thousand inhabitants, and very cheerfully situated about two miles back from the Mediterranean. There are fewer beggars in the streets than in some other of the large Spanish cities, and as a general thing the people have a better look. They are said to be proud, honest, industrious, revengeful and superstitious, hospitable to strangers, fond of love making, pigeon shooting, cock fighting, and bull tormenting, and of every thing else that leads to fighting and bloodshed.

The Plaza de Toros (Place of Bulls) built in 1850, is probably the finest in Spain. It resembles the Roman Coliseum, and has a very imposing substantial look. There are also some very fine public and private botanical gardens. The markets are well supplied with luscious fruits, nuts, and vegetables, but my experience is that the guests of the hotels do not get very much of the good things to be found in the markets. There is here a large cathedral somewhat barren, however, of intrinsic architectural interest compared with others in Spain, but it contains some singular religious pictures. One of them represents the martyrdom of an old saint whose bowels are being drawn out and wound upon a windlass. In strange contrast to this example of human butchery, which has been practised to perfection in Spain, there is a most exquisite head of the sorrowing Virgin painted by Sassoferrato, an Italian painter, whose style was as soft as the finest velvet. It is said that good artists spend a month's time in endeavoring to produce a copy of this surprising little work of art. The sacristy of the church contains, as Capt. Cuttle would say, the *dietical* cup from which our Saviour drank wine at the Last Supper, and which can be seen for a fee on any afternoon about three o'clock if the gentleman can be found who carries the key. He wears a long black robe with girdle about the waist, low-quartered shoes with silver buckles, head surmounted by a black felt hat, very broad brim, which rolls over at the sides like a layer of birch bark. The cup exhibited is of fine silver, neatly made and genuine, of course, as it is said to resemble the one shown in the great painting of Leonardo da Vinci, at Milan. Seriously, I have no doubt that Christ drank from a cup at the Last Supper with his disciples, and it is barely possible that the identical cup is still in existence, but how these ecclesiastics can attempt to palm off upon enlightened travelers so much nonsense and rubbish without laughing is a mystery to me. We have already seen wood enough of the true (?) cross to build a small dwelling house, and we are not half through yet.

Valencia has also a picture gallery that contains a tolerable collection of paintings chiefly by old Spanish artists, nearly all religious subjects. Those old painters must have been a very pious set of men as all their productions show that they had neither taste nor skill for any other class of subjects. We were advised to visit the Church of the Patriarch, founded two centuries ago by Archbishop Ribera, and to witness a dramatic religious ceremonial enacted every Friday, at which time a series of dissolving views are introduced into the service the church being purposely darkened to add impressiveness to the ceremony. We happened to enter at the wrong time and as we were about to commence to exercise the stranger's privilege to see the sights we were told by the sacristan that we could not go round as some one was praying. There were no worshippers, no attendants upon the ceremony except ourselves and the official, but the voice of a human being, as if in the act of chanting prayer, came forth very musically from a dark alcove near to the high altar. The language was unintelligible to us but it seemed like prayer and we quietly withdrew, without having gratified our curiosity. When we were in Granada we attended the cathedral service in the afternoon. The ceremonial was conducted with great pomp and circumstance by twenty-one priests and assistants. I counted all the worshippers and they numbered but sixteen; but all seemed to be very sincere as frequently during the service I noticed that several of them leaned forward and kissed the pavement of the church.

The peasants of Valencia, who labor under the grateful shade of the palm, orange, and mulberry, dress in wide, brown linen drawers, or kilts, with some sort of leggins, and a handkerchief bound around the head, which makes them look like the Bedouins of the desert. The donkeys are the same meek, quiet, patient, unconcerned, perfect pictures of repose that you find everywhere in Spain. We passed one of these animals, however, the other day, and he actually stopped, turned half round, looked at the train as it passed by, and with some signs of emotion; but his brutal master could not permit him to gratify his curiosity even for a moment, without pounding his head and ears.

I have noticed in Spain that for some reason the women look more cheerful, healthy, and robust than the men. They promenade the streets in long dresses, or "street sweepers," and usually with no other covering for the head than a lace veil, and a light shawl or silk mantle thrown carelessly over their shoulders. The men have a cross, dyspeptic look, and wrap themselves up either in the folds of a cloak or shawl, with a woolen muffler tied about the neck and lower part of the face. They are usually inveterate smokers of strong cigars, or cigarettes made of paper and tobacco, which accounts for their bloodless, haggard, and listless appearance. The use of tobacco is so universal that boys, and even children, are often seen smoking in the streets. They pick up the stumps of cigars and convert them into cigarettes, which are certainly quite as cleanly as those that are made in the government tobacco factories.

The climate and soil of Spain are well suited to the growth of tobacco, but its cultivation is prohibited, as I was informed, chiefly with a view to benefit Cuba. Upwards of sixteen million pounds are smoked and snuffed annually, which affords a good idea of the baleful and subtle influence which has so much impaired the manhood of the Spanish race. Some satirist has said that real progress in Spain will not begin until a decree comes forth prohibiting the use of cloaks, knives, and cigarettes. There are, however, heavier clogs than these which drag down the people of Spain, and it will require several violent earthquakes in the social, moral, and religious element of the country before it can begin to regenerate.

The governing classes are unquestionably proud, haughty, and overbearing, destitute of sound principle, and unfit to rule. The next class are the governed, the honest, industrious, working, priest-ridden people, who are mere hewers of wood and drawers of water to the priests and the aristocracy. There is no middling class, as in France and Prussia, to energize the whole mass, and maintain a happy equilibrium between the legitimate powers of the government and the rights of the people. Spain was always financially poor, the slave of expediency, and never poorer than now; and unless something extraordinary turns up, and that very soon, the government will find it very difficult to control the elements which threaten its ruin.

A railway is now building, and is nearly completed, from Valencia to Barcelona, but about half way between the two cities it is necessary to diligence some three hours. Here we underwent another pressure, as every seat was taken, and no provision is made for persons above the ordinary size. However, we lived through it, but upon arriving at Tarragona we were an hour behind time again, and the Barcelona train had gone off and left us; therefore we had no other alternative but to look for lodgings, which we succeeded in finding in the top story of a hotel, where we found comfortable quarters and a very civil Italian landlord, who devoted himself to making our stay agreeable. We thought at one time that he intended to pay us something for stopping with him; but our minds were disabused on that point the next morning. We were glad, on the whole, of the break, as it enabled us to see by beautiful moonlight one of the oldest cities in Europe —Tarragona—founded by the Phenicians, colonized by the Carthegenians, captured by Scipio, and the birth place, it is said, of Pontius Pilate. The historian says it once contained a million of inhabitants; but most likely this referred to a province, and not to a city merely. There is abundant evidence, however, that it was a city of considerable magnificence under the Roman Emperor Augustus, who used to reside here in winter, as the climate was preferable to Rome. The church of San Pablo is so old that the Tarragonese declare that it was built by the Apostle Paul. The Cathedral is also very ancient. It is not known by whom or when it was built, but it is a lofty, noble building, and possesses a very elaborately decorated front, with niches for statues of the apostles and prophets, some of which have disappeared. Tradition says that at one period these niches were full; but that once in a hundred years one of these worthies, getting tired of the repose of the situation, quietly comes down and walks off. Noticing a procession of lighted candles passing into the cathedral, we followed on, and upon entering found that it was lighted up, and a few worshippers were kneeling around the altars. The lighted candles all vanished through "the long-drawn aisle and fretted vaults," and we were left to wonder and speculate upon its significance. Within these old churches there is often met an incongruous mixture of sacred and profane objects. The cloisters of the cathedral of Tarragona, among other curious things, have sculptures of cock fighting, battles between gladiators, and a very curious one that represents some mice solemnly bearing to the grave the remains of a cat, who pretends to be dead; but upon reaching the sepulchre puss throws off her incognito and is up and after her mourning friends, who fly in every direction before the ghastly form.

The road between Valencia and Barcelona passes through a very barren country, and for much of the distance in sight of the blue Mediterranean. The olive tree seems to be the chief dependence of the people in this section. It grows abundantly throughout all Southern Spain, and is much used as a substitute for butter and grease. The people make a dish called *migas*, which is a mixture of crumbs of bread fried in oil, salt and pepper. They also eat bread soaked in oil. Aliens do not usually hanker after these preparations.

Barcelona is the most interprising city in Spain. Its manufactures are very extensive; its excellent harbor is filled with vessels; its public buildings are large and usually fine; its streets are thronged with a busy, bustling people, and everywhere there are visible evidences that it is a city of progress.

It was here that Blasco de Garey launched his steam vessel of two hundred tuns, Jan. 17th, 1543. The records now in the royal archives at Simancas state that the experiment took place in the presence of a committee appointed by Charles V. and Philip II. The invention consisted of a large boiler, which moved by steam two wheels placed at the sides of the vessel. The experiment was a success, but for some reason the king's treasurer, who had conceived a personal spite against the inventor, drew up a report to his royal master, in which he stated that the speed did not exceed two leagues in three hours; that the machinery was complicated, and the boiler liable to burst. Charles V. was so much involved in political schemes that he could not examine the matter with any care, but he paid De Garey all his expenses, and made him a handsome present of money, when the whole thing ended, and the secret, whatever it was, died with the inventor. So runs the narrative.

A short ride of three hours by cars, brought us to Gerona, a strongly fortified place, which some wag has said belongs to Spain in time of peace, and to France in time of war. Here we were booked for a ten-hours diligence ride.

At the frontier, the Spanish official gruffly demanded our passports. Not supposing that they would be required, we had them locked up in our trunks. The conductor of the diligence assured the officer that we were Americans, not Catalonian revolutionists, and as it would make a good deal of trouble to unload the baggage, he hoped we might be permitted to pass on. After some parleying and growling, we were permitted to go on, soon to reach the French frontier and French civility. The officer approached us, touched his hat, and said, "Pardon, monsieur Have you passports?" We replied, "Yes; they are in our trunks." "Excuse me," he said, "of what country are you?" Our answer satisfied him, and we were civilly permitted to proceed, and happy to feel ourselves once more in France, prepared to take a more cheerful view of the condition of bodily life.

Forty days spent in Spain satisfies me that to the artist, the antiquarian, the ecclesiologists, the lover of architecture, and for the mere curiosity-hunter, it is a country of abounding interest. Even its timberless mountains, plains and valleys, and its waterless rivers, are curious to behold; but there is also a loneliness, an absence of homelike feeling, which soon becomes oppressive to those accustomed to the comforts of domestic life in our own country. It is said that even the birds forget their songs in old Spain. S. H. W.

Aluminum for Mathematical Instruments.

MESSRS. EDITORS: In your issue of Vol. XVIII., page 3, I find an article suggesting the advantage of using aluminum, on account of its lightness, instead of brass or German silver, as material for mathematical and surveying instruments. Being a mathematical instrument maker, and knowing the great discomfort of carrying heavy instruments, I have often reflected upon reducing the weight of our usual instruments without impairing their accuracy and strength, but have never fully satisfied myself how it could be accomplished, as their construction is such that any further reduction of the material would be detrimental to the accuracy.

I agree with your correspondent of Helena that aluminum will not only fill the place of brass, but will in many respects be superior to it, and that all mathematical instruments should, if not wholly, be at least partially made of this metal, or of a compound containing it. Aluminum has already been used by Messrs. T. Cook & Sons, of York, England, for their astronomical instruments. When I was there last year there were two large transit telescopes in process of construction, of which the heaviest parts were made of a compound of aluminum and copper, in order to reduce the weight of the telescopes (they being about seven feet long by an opening of the object glass of about six inches), there being no counterpoise, which is generally necessary in order to attain accuracy and an easy management. As at the present the cost of aluminum is too great for general use, until we discover a cheaper and more rapid process of extracting this metal, we must content ourselves by using a compound as above mentioned, which reduces the cost greatly and materially lessens the weight. The cost of working this metal will most probably be somewhat greater than that of brass, and as screws require great strength, in proportion to size, they should be made of German silver.

Aluminum has also proved of great advantage as a material for the smaller weights used in chemical analyses, on account of the greater difference in their sizes and consequent ease of handling.

If "Aluminist" desires to correspond on this subject of constructing instruments of this metal, I should be greatly pleased to answer any inquiry. L. BERGER.

Roxbury, Mass.

[It seems as though the attention of our chemists and practical metal workers might be profitably directed to the subject of a cheap and ready means of extracting aluminum. If procured cheaply it could be applied with great profit and advantage to various manufactures. The failures hitherto of compassing this object should not deter the enterprising and persistent inventor.—EDS.

Bessemer Steel Rails--Homogeneousness of Metals.

MESSRS. EDITORS :—Your notice of the London *Engineer's* article on steel rails, or more particularly, the breaking of the steel rails at the Camden and Chalk Farm stations, may possibly, unless explained, have a tendency to mislead such persons as are not acquainted with the properties of the two metals for railroad and other purposes. I am glad to find that you do not agree with the *Engineer* in its opinions of steel rails.

It seems to me that engineers think that it is a matter of impossibility to make inferior pneumatic steel. It is true, it is not so easy to make poor steel rails as it is to make poor iron rails, for we can box up in a pile an inferior material for rolling into iron rails. But with regard to steel rails there is no piling. The ingots are cast to suit the weight of rail or bar. It is true you can by the use of cast iron, contaminated with sulphur, phosphorus, and other destructive elements, produce an inferior quality of steel. You can also produce an inferior quality of steel by not thoroughly decarbonizing your iron, or by the use of an inferior carburizing material. But with the use of suitable materials, a skillful converter, and the Bessemer machinery, you can produce a homogeneous material with more economy and more certainty than by the old process. In fact I doubt very much if any of the commercial iron produced by the old process could be strictly called homogeneous, and you will, I think, admit that it is not so tough as pneumatic steel or iron, Chalk Farm rail notwithstanding.

Then if the iron is not homogeneous it must be heterogeneous, and a heterogeneous metal is a poor one for rails, for it is a law of physics that if two bodies impinging against each other are heterogeneous (or if one of them be so), there-sult will be electricity, and this electric current has a magnetic action in a direction cutting its own at right angles.

Then, Dufour says the tenacity of iron (homogeneous) is increased by the passage through it of an electric current. Thus, iron wire, 0·009248 m. diameter, which sustained only 2,545 kil., held 2,898 kil. after the action of a current of Bunsen cell during 263 hours. This proves the assertion of Robert Mushet, Esq., that pneumatic steel, in all probability, will gain in toughness by exposure to the atmosphere and to the impact of locomotive wheels, and that the notion of their becoming brittle from the latter cause is a mere phantom of the imagination, in confirmation of which not a single valid argument or proof can be adduced. This is true, and with due respect to the editor of the *Engineer*, my opinion is that Mr. Mushet is a better authority on this subject than he is.

As you say, it is well understood that cold hammering will produce crystallization; but it is not proved that the iron acted on was homogeneous—on the contrary it is more than probable that it was heterogeneous. We have proof that there is no alteration in the molecular structure of homogeneous steel by impact, unless it is that improves its toughness.

When iron is broken with great rapidity there is no time allowed for the exercise of the property of ductility, and the fracture will naturally be crystalline. But if time is given for the metal to exercise this property of ductility the fracture will be fibrous. I have seen the wool drawn over the eyes of inspectors of railroad bars in this way. Take, for instance, two pieces of iron from the same bar, fibrous or otherwise; nick each of them where you want them broken; then bend one of them slowly round a sharp angle, and it will show a fibrous fracture; then let the other be broken short under a monkey, and you will find the fracture highly crystalline. If makers of iron rails who want to get a crystalline head and a fibrous flange from the same kind of iron would take the hint that this idea suggests to them in piling, they would improve the value of their rails very much. But then the day of iron rails is passed; no railroad company that consults its own interest will lay any more iron rails on their lines.

What did the fracture of the broken steel rail that the *Engineer* writes so much about prove? Did it prove it to be uniform in quality, or in other words, did it prove it to be homogeneous? Not at all. Then why, in the name of common sense, condemn steel rails because of the maker's fault? We are aware that some of the makers of iron rails, and especially those that do not feel like going to the expense of putting up pneumatic steel works, will do all they can to impede the progress of the pneumatic process in this country, and probably join issue with such of the English railroad capitalists and free traders as have a large number of puddling furnaces and its machinery in the shape of invested capital, that would of course depreciate in value should the process become more adopted. "Birds of a feather will flock together," as they say; but the day is passed to make a retrograde movement with regard to pneumatic steel in this country. It is all very well for those old fossils who would not read the handwriting on the wall a few years ago, and who have built works for the production of iron rails, to chuckle at this so-called failure of steel rails; but before it can be called a failure let us have some proof of it in such a way that it can be understood.

In view of the late frightful railroad accidents, the public demands that tough, homogeneous steel rails, steel tires, axles, etc., be used in the construction of railroad plant. Alteration of molecular structure by impact is a bugbear—a humbug. Impact improves the tenacity of homogeneous steel rails. And with the aid of this last beautiful invention of Mr. Saxby's of testing iron by magnetism, an imperfect bar can be detected at the mill and of course rejected, so that there need be nothing used but perfectly homogeneous bars, which will increase in toughness the longer they are in use. W. G. JR.

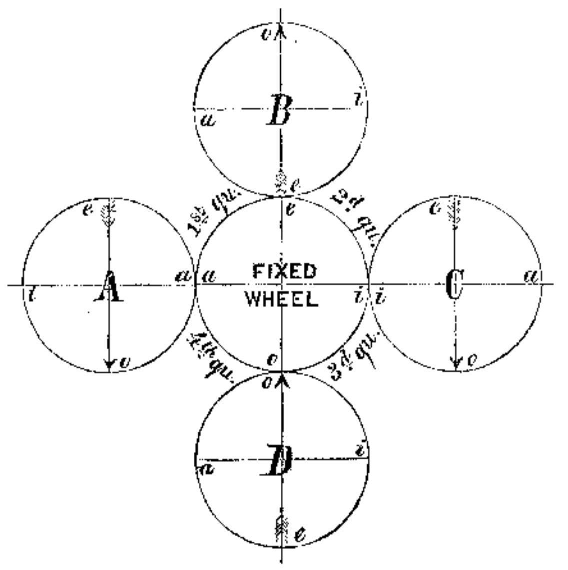
Pottsville, Pa.

Turning a Movable Wheel Around a Fixed Wheel.

MESSRS. H. M. T., Vol. XVI., page 347, inquires:—"How many revolutions, on its own axis, will a wheel make in rolling once around a fixed wheel of same size?" You answer "one."

D. S H., Vol. XVII., page 39 says "two." You dissent, and adhere to "one."

Now, premising the self-evident fact, that two diametrically opposite points on the periphery of a wheel cannot exchange places without a half revolution of the wheel, I think the question will be definitely solved by the showing of this diagram :



A marks the position of the wheel before moving—the opposite points on its periphery being shown by the arrow, now pointing *downward*. Roll the wheel over one quadrant of the fixed wheel, and it takes the position, B, the arrow pointing *upward*. The opposite points have exchanged places, therefore the wheel has made a half revolution. Rolling over the second quadrant brings it to the position, C, the arrow pointing *downward*. Here the points are again reversed, indicating another half-revolution, and the two halves constituting *one* complete revolution in rolling over *half* of the circumference of the fixed wheel. Rolling it over the remaining half will of course duplicate the above results. Therefore, the number of "revolutions, on its own axis, that a wheel will make in rolling once around a fixed wheel of same size," is *two*. Don't you think so? L. M.

Germantown, Phila.

[No, we don't think so! We still adhere to "one," and our correspondent, by his diagram, proves himself wrong. The true starting point is at *a a*, and by observing the several positions of *a*, in the diagram, it will be noticed that the moving wheel makes just one revolution in rolling around the fixed wheel.—EDS.

Raising Water Through Tubes.

MESSRS. EDITORS :—On page 387, Vol. XVII., SCIENTIFIC AMERICAN, your correspondent under the head of "Relative Size of Pump Barrels and Tubes," entertains and communicates erroneous ideas. He says, "1st, The pressure upon piston valves of different sizes in *sustaining* water at the same hight is in proportion to their areas." The pressure on any valve is just the same when in the pump at work as when out of the pump, that is, equal on all sides. As to the sustaining of a column of water in the feed pipe of a pump, all persons conversant with philosophy know it to be by atmospheric pressure on the surface of water from whence it is fed—not by any valve. This will also apply to his second statement.

"3d, The pressure upon valves generally must be in proportion to the products of their areas into the hights at which the water is sustained or raised, etc." Generally! why not always? The laws of nature are unyielding and inevitable, Again, "the greater the amount of friction of the water against its sides in delivering the same quantity of water, and the larger the pump, the greater the quantity of water required in the same time, which would also increase the friction, etc." The first statement is true, but the one following it is erroneous. If we take two pumps, one of double the area of cross section of the other, and the same length of stroke, and run the small one just twice the velocity of the large one, it will require the same amount of water and deliver it with no more ease. In the next place, it matters not how a vacuum is formed at the head of the pipe, the friction is limited by atmospheric pressure. The mechanism used in forming the vacuum at the top of a pump pipe has nothing whatever to do with the quantity of water passing through; the size of the pipe only can govern the quantity. If water be throttled by the incapacity of the feed pipe or the valve opening (which is quite as apt to be the case) so that the water does not follow the piston of a pump as fast as it travels, the speed of the pump should be reduced to the capacity of the supply, or the pipe or valve opening should be increased, as the case may need. A knowledge of natural philosophy with a little common sense to apply it will make all pump difficulties vanish. A. K. SMITH.

Nebraska, Ohio.

Influence of Artificial Illumination on the Quality of the Air in Dwelling Houses.

MESSRS. EDITORS :—Carbonic acid gas is known to be very injurious to health, and it is, probably, the prevalent cause of bad air. This gas is constantly generated by the various contrivances for artificial light; but no experiments have until lately been made as to the value which this factor of the impurity of air may reach under different circumstances. Dumas states the important fact, that in gas illumination, both the consumption of oxygen and the production of carbonic acid is very considerable. In the *Journal for Biology*, of 1867, Dr. Zoch, a Hungarian chemist, communicates a series of determinations on the increase of carbonic acid in illuminating a room of a known capacity with gas, kerosene, and rape seed oil. Consumption of the lighting material, time, and intensity of light were self-evidently taken into account. In the following table the reader will find the increase of carbonic acid gas in the three modes of illumination calculated for the space of 100 cubic meters (131 cubic yards), and upon a lighting effect of 10 normal flames (1 normal candle = a stearin candle of ¼ lb.), at the time of 1, 2, 3, and 4 hours.

Increase of CO_2 per thousand:

Burning Time.	Kerosene.	Street Gas.	Rape Seed Oil.
1h	0,929	0,708	0,537
2h	1,456	1,342	1,038
3h	1,779	1,513	1,190
4h	1,811	1,562	1,229

From this table it may be seen that rape seed oil illumination generates the smallest amount of carbonic acid gas, and and kerosene most. As this mode of illumination is not very general, it is of no great practical importance that kerosene contributes most to vitiate the air, but it is a very different affair with gas illumination. Who has not noticed of late years in the illumination, of the stores, theaters, concert, and political halls of our great cities the fact that each attempts to rival his neighbor in the glaring effect of gas light, but at the same time who has not also made the observation that the greater the light the greater the oppressiveness and vitiation of the atmosphere. It is certain that this sentiment of discomfort is partly to be attributed to the radiant heat emitted by the flames, but the carbonic acid gas is nevertheless to be considered as its chief cause. The normal amount of this gas in the atmosphere is 0·50 to 0·65 per thousand, and an amount of from 2·75 is only to be met with in hospitals, prisons, and garrisons, where the process of respiration of many individuals is going on.

Artificial Writing Slates and Blackboards.

MESSRS. EDITORS :—On page 391, Vol. XVII., a correspondent asks the best recipe for painting blackboards or plastered walls; allow me to communicate the recipe I prescribed for painting more than 2,000 square feet of blackboard on the plastered walls of the class rooms in the Cooper Institute in this city, when it was organized in 1859; and also several hundred square feet in Girard College, Philadelphia, when I was connected there, as it gave perfect satisfaction and is still used in these institutions.

I first have the place of the wall intended to be covered, surrounded by a narrow wooden molding, which may be covered by paint. Japan or varnish is necessary in the paint, as with benzine alone the lampblack rubs off; but as varnish makes the board too smooth to write on, I mix a little fine emery in it, to make it slightly gritty, like a slate; too much emery or a quality of too coarse a grade makes the removal of the chalk marks difficult. For the last purpose I take sheepskin with the wool on, nailed on a small piece of board and always used dry; it is much better than any thing else. From time to time, however, the whole blackboard is cleaned with a wet sponge. The best substance for fixing the common lampblack and emery, is shellac dissolved in alcohol; the quantities are regulated by the circumstances. In warm weather it requires more alcohol. Too much shellac makes the solution too thick; too little causes it to come off. It is to be put on with a flat brush as rapidly as possible, as it dries at once. The blackboard may be used in less than half an hour after being coated. I never noticed the exact proportions used, but had it mixed, and tested it by putting a little on the wall, and added any of the necessary ingredients till it answered the purpose intended.

New York City. P. H. Vander Weyde, M. D.

Saws and their Capabilities.

Messrs. Editors:—In the Scientific American of November 2d, 1867, Mr. Emerson, in answer to some remarks made by Mr Lamar Foss, concerning the power necessary to cut lumber, says that one horse power will cut 1,000 feet of lumber in ten hours running. It appears to me that Mr. Emerson takes exception to a general rule; claiming to do that amount of work with nice, clear, soft, and picked timber. Such is not generally the case; a mill must cut good, bad, and indifferent, hard and soft timber; and I would have supposed that Mr. Emerson would have aimed at giving us a unit power, if I may say so, for cutting 1,000 feet of lumber in a given time, answering the wants of the country at large, instead of making it a sectional affair. The first statement made about that big saw was such that it would induce the reader to believe that fifty horse power would drive it four hundred revolutions in a minute, with six inches feed, through a cut forty-one inches deep. Such a thing is impossible. At that rate, 50,000 feet of lumber in ten hours, with such a speed and feed, would be a very poor day's work. If 50,000 feet of lumber is considered a good day's work, such a big saw is not necessary. I am now running a fifty inch saw, and can cut 50,000 feet of Oregon fir (Douglas pine) in ten hours. One filing lasts us from four to six hours. My rule for applying power to circular saws is the following, the result of experience:

Taking seven-eighths of an inch for maximum feed for each single tooth, and two horse power being the power necessary to drive such tooth through a bolt six inches in thickness, at the rate of 500 revolutions a minute, it would follow that if I wanted to run a saw at such a speed and feed through eighteen inches, using sixteen teeth, or two inches feed, I would have $16\times2\times3=96$ horse power, to be directly applied to the saw. If more or less feed is required, more or less power must be applied in proportion. From the foregoing rules, if the charge of applying power to that big saw was entrusted to me, and if it was really expected from me to run it with the feed and speed before mentioned, allowing only 36 inches cut, I would want $48\times2\times6=576\times4=460\frac{80}{100}$ horse power; and with suitable timber as regard to size and length, I would expect to cut over 200,000 feet of inch boards in ten hours, if the whole could be handled fast enough.

As a last remark, I would say that I believe, from my observations, that it requires fully three horse power to cut 1,000 feet of lumber in ten hours; two for the main saw, and one for the edger, that I have supposed to be at hand for the purpose. These conclusions come from trials made, where a dynamometer was used to ascertain the amount of the motive power, and the timber used was Oregon fir, which I suppose might be considered of average hardness as regards timber generally. It would be well for those engaged in manufacturing lumber to know rather than guess, and a few communications through your valuable paper, no matter how contradictory they might be, would not fail to throw more light on a subject that is yet not well understood. It would be well, if any communication is made, to have the motive power tested, and that on the saw mandrel. J. A. Lesourd.

Oak Point, Washington Territory.

Electrical Phenomenon.

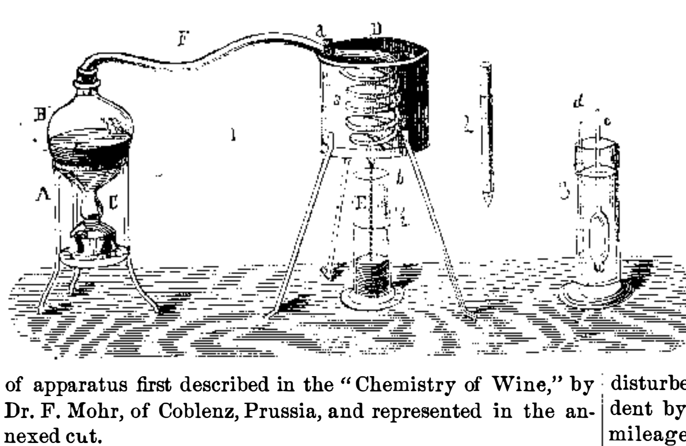
The Rochester *Union* says that one of the most beautiful electrical phenomena imaginable was lately witnessed in the office of the Atlantic and Pacific Telegraph Line. Wire No. 1 of this line was down between this city and Syracuse. Suddenly it was discovered that neither wire would work. A continuous current of electricity was then observed to be passing over the wires through the several instruments, and this while the batteries were detached. The current seemed to be of the volume of a medium-sized pipe stem, and it gave the several colors of the rainbow, beautiful to behold. With the key open, the current flowed in waves or undulations, and from the surcharged wire it would leap over the insulated portions of the key and flow along the wires beyond. The same phenomenon was observed at Buffalo and at Cleveland. The gas in the office here was lighted without difficulty by holding the end of a wire within an inch or two of the gas burner. The current was intense enough to shock one holding the wires or instruments—indeed, one of the employés of the office had his fingers scorched by the current. With closed keys the current was continuous, as before stated.

The theory advanced by an experienced electrician is this. The electrical equilibrium of the atmosphere had become disturbed by the sudden and extreme cold of the past two days—and we may say here that this phenomenon has never been witnessed except when cold weather prevails extensively—the electricity, instead of descending to the earth as in a thunder storm or in warm weather, ascends in the atmosphere, thus destroying the equilibrium and producing these magnificent displays. The broken wire spoken of, which rested on the ground, was the point of communication for the current from the earth. The electrician advances the theory that Aurora Borealis is produced from the same causes, and we submit that it is not an improbable theory. Every one has seen, undoubtedly, the wavy or undulating motions of the Aurora Borealis, and the wavy motions of the current last night with the batteries off and the key open were precisely the same.

Here we may notice one thing not generally known. A portion of the Irrepressible Conflict speech of Wm. H. Seward in this city, a few years since was telegraphed to New York and from Boston to Portland by the electrical influences of the Aurora Borealis—all the batteries on the line being detached. This feat, it is said, has never been repeated.

APPARATUS FOR DETERMINING THE AMOUNT OF ALCOHOL IN FERMENTED LIQUORS.

For the quantitative determination of alcohol in simple alcoholic mixtures the specific gravity plan is generally made use of. This method being based upon the difference which exists between the specific weights of the liquids, recommends itself for correctness and simplicity, and is therefore most applicable for practical use. For liquids, however, in which the alcohol is associated with several substances, this method cannot be employed, for the alcoholic strength bears no distinct relation to the specific gravity of the same. But as it is of great importance for wine and cider manufacturers, as well as for brewers and distillers, to be enabled to determine at any time, during and after the process of fermentation, the exact amount of alcohol of the respective liquids, a practical method for obtaining this end must be considered as of great value, and such appears to be the form



of apparatus first described in the "Chemistry of Wine," by Dr. F. Mohr, of Coblenz, Prussia, and represented in the annexed cut.

A brass frame, A, supports a glass reservoir, B, having a capacity for holding about seven liquid ounces. In the brass water receptacle, D, is a coil of cooling pipe, connected with the glass reservoir and terminating just above the cylinder, E.

To ascertain the proportion of alcohol in any liquor, the cylinder, E, is filled with it, full up to mark, *b*, and this entire quantity being emptied into receptacle, B, heat is applied beneath. Cooler, D, having been filled with cold water, the vapors conducted through pipe, F, are condensed, and drop into the cylinder, E.

The distillate having collected therein precisely up to mark, ½, the alcohol lamp is to be extinguished, and cold distilled water or rain water added thereto, up to mark, *b*. In order not to transgress said mark, the pipette, Fig. 2, is used, by which the water can be added by drops. If then the indications of the hydrometer (Fig. 3) and the thermometer are marked down, the tube accompanying the apparatus will show the precise alcoholic strength of the substance distilled. The table is simple and easily understood. We are informed that Henry Guth, optician, 104 Delancey street, New York, furnishes these apparatus.

Car Wheels---Their Composition and Causes of Breakage.

With the frequent accidents caused by the breaking of car wheels, we know, says the *American Railroad Journal*, of no subject connected with railways demanding greater attention on the part of engineers than the use of the strongest wheels.

In most treatises on iron, the texture of cast iron is said to be granular, it is in fact crystallized as found by chemical experiment and microscopic investigation. Crystals of gray iron being octahedral, their maximum limit when cubic, being $\frac{1}{15000}$ of an inch in linear dimension, and about $\frac{1}{2000000000}$ of a grain in weight; crystals in white or chilled iron are smaller, and most frequently occur in six sided prisms, sometimes connected in fascicles by their ends, at other by their sides, in a sort of stellated or radiated arrangement, as may be readily observed in a fragment from the tread of a chilled wheel.

The density of cast iron is from 7.1 to 7.5 of a porous nature, under hydraulic pressure water having been forced through four inches of metal. By remelting in an air furnace, its strength has been increased up to twelve meltings, though the same result has not been found with the cupola.

The purer the iron is from foreign particles the greater cohesion its crystals have with each other, which constitutes the difference between strong and weak irons. So great is its affinity for other substances, that its ores are seldom found pure, and as the foreign matters form the quality of the metal smelted from the ores, it is evident that each peculiarity of the ore is imparted to the iron made from it.

The best qualities of charcoal pig iron give, by analysis: Iron, 96,992 per cent; carbon, 2,800; silicon, 0,208, with traces of manganese and copper. The tensile strength of the pig, from 18,000 to 28,000 pounds per square inch. Remelted iron from 31,000 to 41,000 pounds.

Charcoal, the fuel with which the ores are smelted. when new and pure, consist of carbon 97 parts, ashes 3 parts. When old, carbon 85 parts, water 12 parts, ashes 3 parts. The best qualities of ores and the fuel show an entire freedom from either sulphur or phosphorus.

The effect of sulphur on iron is to cause brittleness at all temperatures, red shortness when hot, to such a degree that experiment has shown that even $\frac{1}{30000}$ of sulphur is enough to produce brittleness, and $\frac{1}{10000}$ red shortness.

Phosphorus imparts the quality of shortness at low temperatures, and there are but few irons in which a trace of this substance cannot be found. One per cent of phosphorus rendering iron to be of a very bad quality and of limited use.

In the manufacture of car wheels, the pig metal is melted with anthracite coal in the cupola. Anthracite coal contains carbon 88.50 parts, volatile matter 7.50 parts, ashes 4.00. Average specimens of white ash anthracite coal from Pennsylvania contains in 100 parts sulphur 0.91 per cent. All varieties of hard coal contain sulphur in a more or less degree, combined with iron in the form of iron pyrites, disseminated through the coal. Anthracite iron, or iron smelted with anthracite coal, from its want of strength owing to the sulphur and other impurities in it, is never used for car wheels.

Having noted the peculiarities of the best charcoal irons, and charcoal, as compared with anthracite iron and anthracite coal, it becomes a matter of much importance to inquire how far these elements effect the car wheels as generally supplied to railroad companies.

But few, if any, railroads would be willing to risk the use of car wheels made from anthracite iron, even if a proper chill could be put on them to insure wear. The general practice is to remelt the old car wheels with anthracite coal, using from one third to two thirds of new metal. With each remelting the affinity of the iron for foreign substances absorbs the sulphur from the coal, resulting, with each remelting of the old wheels, in a weaker iron, and thus the process goes on from year to year.

How near the mixture thus made, claimed to be pure charcoal iron, is the genuine article, can readily be conjectured; but with this process comes poor wheels, breakage, and loss of life.

Cast iron, when in constant vibration, as in a car wheel in use under express cars, soon wears out, or "become tired," the granular formation is disturbed by the repeated jar of continued motion, as is evident by the failure of wheels under express cars, with less mileage than wheels under cars or engines with frequent stops or long periods of rest.

Another great cause of breakage is due to the extreme pressure used in pushing the wheels upon the axle; a pressure of 10 to 12 tuns per wheel holding it fast, as well as 30 or 40 tuns as is frequently used, which strains the wheel, ending in a cracked wheel after a short time in use.

With a knowledge of these facts one year ago, an extensive car wheel works was established at Ramapo, N. Y., on the Erie railway, for the purpose of making wheels entirely of pure metal from the Richmond and Salisbury mines.

The Richmond iron, famous for ordnance—the United States Government having used not less than twelve thousand tuns for guns—and recently so successfully tried in the Rodman Gun trial at Shoeburyness, England, having a tensile strength of from 31,000 to 41,000 pounds per square inch, has proved itself to be one of the strongest of cast irons for guns.

To ascertain its relative strength in car wheels, experiments were made by the Pennsylvania Railroad Company, July 17th, 1867, in comparison with the wheels in use on this road as follows:

No.	Maker.	Size. in.	Weight. lbs.	*Blows on each wheel.			Total No. of blows.
1	Omitted	33	496	49	24	13	86
2	"	32	631	21	21	45	87
3	"	33	546	9	7	23	39
4	Ramapo	33	519	59	152	80	291
5	Omitted	33	549	36	28	—	64
6	"	32	513	51	43	—	94
7	"	33	510	20	9	12	41

* Each wheel was tested in three places, if not destroyed by previous blows.

By the first set of blows given, all of the wheels, with the exception of the Ramapo wheel, were entirely destroyed, the subsequent blows being given to test various portions of the remaining plates.

The Ramapo wheel, with each trial, was only dented or crushed in, and after many repeated blows on the rim, a portion was broken out to show the texture of the iron.

As to the wearing qualities of the Ramapo wheel, the Erie Railway Company report them equal to any in use. On the Morris and Essex railroad out of 700 wheels in constant use over nine months, with a constant load of 10 tuns per car, running 400 miles a week, but one wheel has failed, and that caused by accident. Similar results are reported from other roads using them. The cost is somewhat higher than the ordinary class of wheels, but the wear and great security amply repay it.

Action of Ozone on Sensitive Photographic Plates.

Dr. Emerson Reynolds stated before the Dublin Chemical and Philosophical Club that he had been performing some experiments upon the above subject, and that he had found that when the latent image (i. e., the image before it was developed) was submitted to the action of ozone it was completely obliterated—not only was it impossible to develop the image, but a second image might be retaken in the camera upon the same plate. The author remarked that this was against the theory which might be called the mechanical theory of photographic images, and proved conclusively that it was due to chemical change in the sensitive film. He also thought that many of the disputes in connection with the length of time dry plates might remain sensitive, was probably owing more or less to the quantity of ozone present in the air.

The ozone used in these experiments was in some cases procured by passing atmospheric air over phosphorus, and in others by the silent discharge, viz., by attaching one of the platinum wires of the reservoir to the prime conductor of a machine, and turning it slowly, the other wire being in communication with the ground.