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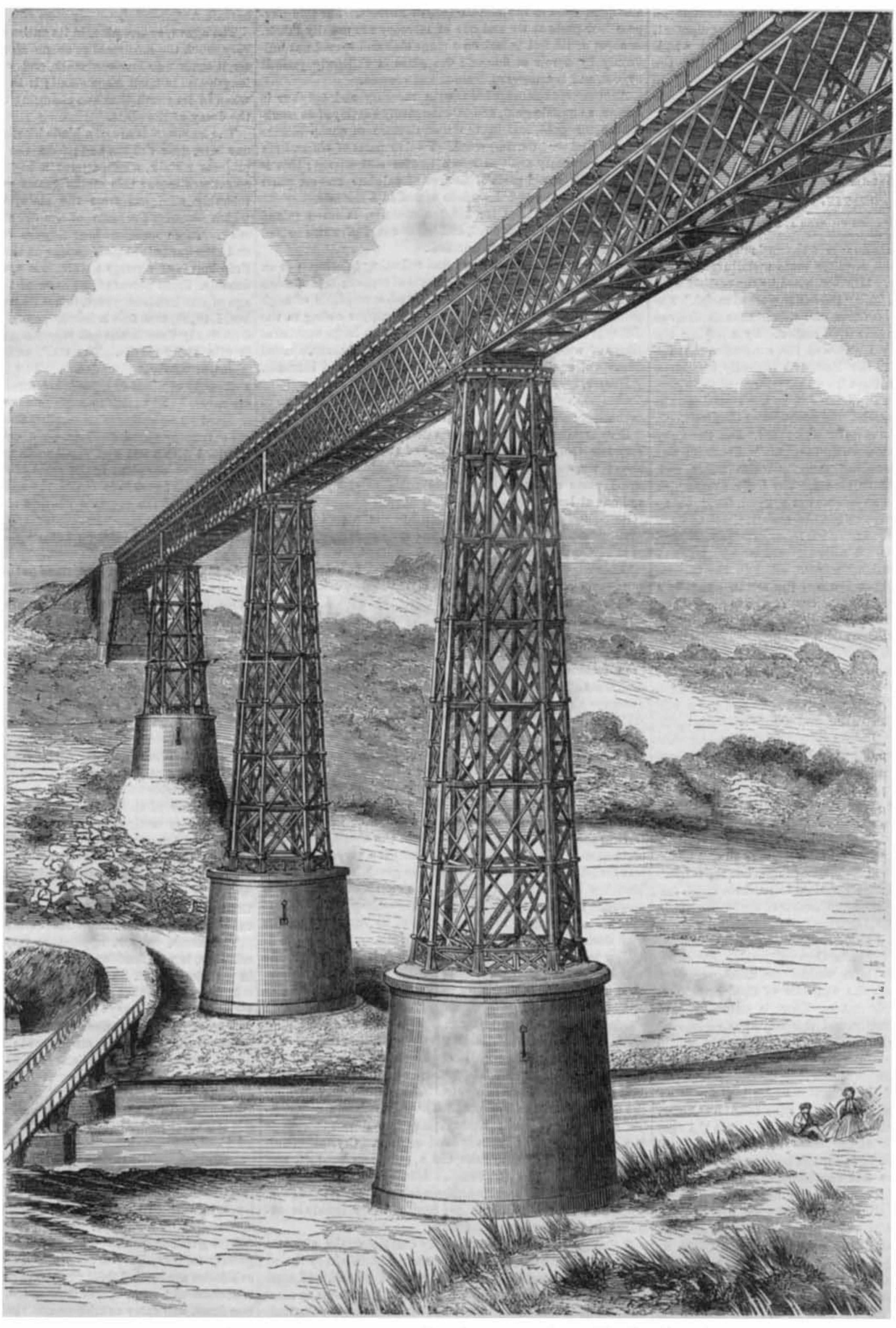
The Cere Viaduct.

The viaduct which we illustrate this week crosses the Valley of the Cere, near Ribeyres, and is situate on the line of railway between Figcas and Aurillac, which forms a portion of the central network of the Paris and Orleans Railway, France. The viaduct, which carries the rails at a hight of 181 feet 6 inches above the water level, consists of five spans of lattice girders supported by masonry abutments and by piers formed of clusters of cast-iron columns rising from bases of masonry. The three central spans are of 164 feet each and of the two other spans, that on the one side is 145 feet, and the other 139 feet. The length of each abutment is 118 feet, the total length of the viaduct being 1,012 feet. The width of the viaduct between the rails is 14 feet 9 inches, and it carries a single line of rails. Each of the piers consists of a cluster of eight cast-iron columns united by cross bracings, and fixed to the top of a brickwork base of elliptical shape. Each pier measures 16 feet 5 inches by 8 feet 2½ inches from center to center of columns at the level of the capping, and the columns are disposed at such an inclination that their center lines, if produced upwards, would all meet at a point at 123 feet 1½ inches above the level of the rails. The side columns of each pier have thus a batter in the direction of the line of the viaduct of 1 in 30, and the end columns a transverse batter of 1 in 15, and as all the piers are of the same size at the top, the dimensions of each at the bottom vary with the hight. The brickwork bases of the piers have also their sides built at such inclinations that they form portions of a cone, the apex of which would be at the point of junction of the center lines of the columns before mentioned. The foundations of the viaduct were commenced in June, 1863, the erection of the girders in May, 1865, and by the following October a connection had been formed between the two abutments.

When complete the superstructure was tested by a load of 4,000 kilog. per meter, or about 8,000 lbs. per yard run; and under this test the central piers were compressed 3 millimeters, or about an eighth of an inch. At the same time the central span was deflected 15 millimeters, or three fifths of an inch, and the two spans on each side of it 12 millimeters, or nearly half an inch.

Its total cost was $171,000 in gold. Each of the main piers contains 71 tuns 13 cwt. of cast iron and 51 tuns 10 cwt. of wrought iron, and the cost per yard in hight of the iron portion of the pier was about $400.

The viaduct was constructed under the direction of M. Déglin, engineer-in-chief of the Ponts et Chaussees, and of Mr. Bortoux, acting engineer. The design was by M. Wilhelm Nordling, engineer-in-chief of the northern part of the Reseau-Central.



VIADUCT ON THE PARIS AND ORLEANS RAILWAY, FRANCE.

Railway Economy.

There seems to be a great difference of opinion among railway managers as to the meaning of economy as relating to the roads they operate. By far the greater number apparently holding that it is in cheapness of first cost, without regard to service to be rendered. This has been *the* fault, not only in the working, but in the construction of American railways.

Originally, owing to the scarcity of capital and the necessity of rushing the enterprise through to completion, the roads were hastily graded, insufficiently ballasted, and laid with any iron that could by any possibility be considered as at all suitable, and which cost the least sum per net tun. So, in rolling stock, wheels which have so much to do with the safe transmission of the passengers and freight, were not purchased because of the quality of material used in their composition and the care bestowed upon their casting; but the only question asked was, "What is your price?"

It is no wonder that under such circumstances as these American railways have made themselves illustrious as one of Grim Death's most efficient allies. We believe that an examination of the causes of casualties on rail roads will show that of every hundred, ninety-nine have arisen from either a defective wheel, or axle, or rail.

The expenditure of one or two cents a pound more for axles, of three or four dollars additional per wheel, and a few dollars per tun extra for rails, would, we firmly believe, do more to reduce the list of accidents on railways than any other course of action their managers could pursue. Railway supply manufacturers are not slow to discover that it is cheapness, not quality, that secures orders.

Pity 'tis that railway managers have not been as quick to understand that the "penny wise" are frequently the "pound foolish;" that the best is always the cheapest in the long run; that that policy which hall secure to them the most complete road-bed and the most thoroughly reliable equipment, is the one which will also enable them to reduce cost of track repairs per mile, cost of car repairs per tun per mile, and loss and damage to goods and passengers to a mere nothing, compared with what they would be under the reverse rule. Safety and speed can both be increased, and with these comes, what all are striving for, larger traffic. Surely, it seems to us, it is not very difficult to see that when a wheel which would cost $22 would prevent an accident involving the payment of thousands of dollars of damage caused by a wheel whose price was $18, it is better to pay the $22. Yet managers buy the $18 one, and trust to good fortune to protect them from ill-consequences.

The public, who risk life and property on railways each and every day, have a most unmistakable interest in these things, and an undoubted right—we had almost said duty—to declare through their representatives, that it shall be a crime, properly punishable, for railway managers to decrease safety in order to secure cheapness.

We are glad to know that some of these gentlemen can see their own and the public's interest without any forcing, prominent among whom is the superintendent of a road some sixty-four miles long, running through a difficult country, all grades, and tunnels, and trestle-work, and yet the record of whose accidents will compare *most* favorably with many better located roads, and his secret is, testing the materials he uses in his track and on his motive power and car equipment, testing them thoroughly, and then purchasing that which shows best service, whether its first cost is greater than the others or not.

If managers generally were as wise, we should soon have the pleasure of reporting a decreased mortality and a lessened damage account on railways.—*Railroad and Travellers' Journal.*

[For the Scientific American.]

ON TIN.

BY PROFESSOR CHARLES A. JOY.

Tin is one of the metals known to the ancients, although it does not occur native, and requires some metallurgic knowlege for its preparation. It is mentioned by the earliest writers, and was called by Homer "the easily worked metal." The Greek name for it was *cassiteros*, and this in turn is derived from the still older Sanscrit word *castira*. By studying the derivation of the name we arrive at the conclusion that the metal was well known in the East, and probably was introduced to the Western nations from that quarter of the globe. Later in our history it was discovered by the Phœnicians in what they called Cassiterides and we know as Cornwall.

The Romans called the metal "white lead," and the Celts *stean* or *ystaen*, from which we derive "tin." Stannum was first used for argentiferous lead, then for white metals, and, finally, in the fourth century, for tin. The Latin name which is used in pharmacy, and affords us our symbol, Sn., is therefore of comparatively recent origin. In ancient times the uses of tin were chiefly for bronze and for mirrors. The famous mirrors of Brundusium were alloys of copper and tin, and were afterwards replaced by silver. Even in the Middle Ages there was a very limited use of the metal, and it is a curious fact that no specimens of antique tin have come down to us. The alchemistic name of tin was Jupiter, and many were the attempts made to convert it into gold. The chief ore of tin is the oxide or tin stone, from which it is easily separated by coal. The easy working of the ore accounts for the knowledge possessed of it by the ancients. There is a tin pyrites, or compound of sulphur, copper, and tin, and a silicate. The metal has also been found associated with tantalum, tungsten, and columbium, in certain rare minerals, and, in Bolivia and the Ural mountains, is said to occur native. Traces of tin have been discovered in mineral waters, to which, however, it imparts no poisonous properties. We do not find that it plays any conspicuous part in the animal or vegetable kingdom. America otherwise so rich in metals has hitherto produced very small quantities of tin. There are rumors of its occurrence in large quantities in Missouri, also in California, in Durango, Mexico, and in New Hampshire, but these localities have not been sufficiently worked to produce much impression on the market. The production of tin in Europe in 1865 amounted to 19,140,000 lbs., the value of which was about $4,740,000 gold; of this 18,590,000 lbs. came from Great Britain. It is said that the mines in Cornwall, which, according to some authorities, have been worked for 3,000 years, are gradually giving out, but the statistics of the annual production do not confirm this rumor. There is naturally more demand for tin than formerly, and this may have occasioned the rumor of the falling off in the Cornish mines.

The mode of extracting metallic tin from the ores is fully described on page 79, current volume.

The properties of tin have been well understood for many centuries. It is rare, indeed, to take up a metal our knowledge of which has been so slightly increased, as is the case with tin. The literature of any other metal, especially of the rare metals, is very copious for the last twenty years, but under the head of tin we find very little that is new. It is true that the number of its compounds has been materially increased until there are about two hundred and fifty of them described in the text-books and journals. To some portions of an able lecture recently delivered by Professor Stone, at the Cooper Union, we add a few scattered facts obtained from recent publications.

Tin has a well-known white color, with a yellow tinge and a high metallic luster. At 213° Fah. its ductility is so far increased that it can be drawn into wire. At ordinary temperatures it is not very ductile. The malleability of the metal is one of the chief occasions of its usefulness, as it is in the form of foil that it has such extensive application. An ingenious method for the manufacture of tin foil was invented by Mr. Crookes, of New York city, it consists in hammering plates of tin by placing them on top of each other. As fast as a given sheet becomes large and unwieldy, it is cut off and laid on top, and in the course of time one hundred sheets are piled one on the other, like so many quires of paper. They do not adhere together, and the workmen can, in this way, produce very thin foil. Much of the work can be done by machinery, but as the inspectors of tobacco require a foil of a particular thinness, the exact point can only be ascertained by the fingers. It requires a very expert workman to decide when the foil has reached the exact fineness to suit the officers, and no machine can take his place. Metallic tin imparts a characteristic odor to the moist hand, it also has what is called the tin cry when it is bent. This property affords a means for testing bars of tin to distinguish them from solder. Plumbers are in the habit of holding the ingots to their ears and giving them a bend. They can thus separate bars of tin, lead, and solder from each other. Cadmium is the only metal that resembles tin in this respect. Although tin melts at so low a point as 442° Fah., it is not sensibly volatilized. It requires a high heat to convert it into a vapor. The metal slowly tarnishes in the air, and is rapidly oxidized at a red heat. It readily combines with mercury, producing the well-known amalgam used in the manufacture of mirrors. For this purpose four parts of tin and one of mercury are usually taken. A sheet of tin foil is laid on a stone slab and spread out uniformly by a roll of flannel; the glass is skillfully pushed over it, and is afterward drained and pressed.

Another compound of tin with mercury and sulphur is known as mosaic gold, and is extensively employed as a substitute for gold leaf in the manufacture of cheap picture frames and for bronzing wood. Twelve parts of tin and six parts of mercury are put into a mortar and stirred; this is mixed with seven parts of flowers of sulphur and six parts of sal ammoniac, and the whole heated in a matrass.

Tin, such as is used for kitchen utensils, is often mixed with eighteen per cent lead, and hence could give rise to lead poisoning if incautiously handled.

Speculum metal for mirrors and reflecting telescopes is an alloy of one part of tin and two parts of copper; it is of steel-white color, extremely hard, brittle, and susceptible of high polish. It is difficult to unite tin and copper owing to the different densities of the metals. There are a large number of alloys of which tin is a valuable constituent. Britannia metal consists of equal parts of brass, tin, antimony, and bismuth.

Pewter, four parts of tin and one of lead.

Common spoons, queen's metal, nine parts of tin, one of antimony, one of bismuth, and one of lead.

Rose metal, which is used for safety plugs, and melts at a very low temperature, is composed of two parts of bismuth, one of tin, and one of lead. Plumbers' solder is made up of equal parts of tin and lead; fine solder of two parts of tin and one of lead.

Bell metal is variously constituted; it is sometimes composed of seventy-eight parts of copper and twenty-two parts of tin. Gun metal has less tin. Bronze less tin with three or four per cent zinc. It is an interesting fact that bronze cooled slowly, is brittle, and, suddenly, is malleable, exhibiting a property just the opposite of steel.

Tin is used by calico printers and dyers for making "spirit mordants" and "stannate salts," and imparts crimson hues and azure colors to various materials. This application has been seriously interfered with by the new industry in aniline, where the colors are of a greater variety and the mordants are albumen instead of metallic salts. There was a period in our history when we imported nearly all of the white metal and Britannia ware for the various utensils of the table and kitchen. Now we manufacture most of our table service and also work up great quantities of tin ware. In beauty of design and perfection of workmanship our plated ware is equal to any manufactured in England or France, and we have no longer occasion to send to Europe for such articles. During the year ending June 30, 1869, the total importation of tin amounted to $10,300,000 upon which a very heavy duty was levied by the government to the great injury of many branches of manufacture where the article is largely employed. Tin ware is used by all classes—the poor as well as the rich—and ought to be encumbered as little as possible with duties and taxes.

How to use waste scraps profitably has long attracted the attention of metallurgists, and various methods have been employed. In New York city the scraps are put into circular iron baskets and subjected to great heat. The tin runs off and is collected in a suitable receptacle. The iron remaining after the removal of the tin, is not wasted, but is employed in various metallurgical operations. Sometimes the tin is economized by converting it into stannate of soda used as a mordant in dyeing. There are numerous ways of accomplishing the separation of the tin from the iron and subsequently combining it with the soda. One of them is to digest the scraps in a proper mixture of soda lye and sulphur. Crystals of sulphate of soda or glauber salts are a secondary product, and collect on the sides of the vessel. After filtration, the liquid is evaporated to dryness, and affords cakes of stannate of soda. Sometimes twelve to fifteen per cent of the stannate is obtained in this way from the scraps.

A fine green color is obtained by combining the stannate with a salt of copper, and a pink color for porcelain by fusing together stannic acid, quartz, bichromate of potash, and some chalk. The poisonous properties of lead have been so often fatally tested that many efforts have been made to substitute tin tubing in its place. The cost of the material has hitherto been a serious drawback, but the invention of a method of producing lead-incased tin pipe has obviated much of this difficulty, and encouraged the hope that tin pipe can be general ly substituted for lead. The use of tin and its salts, as reducing agents, is one of the most recent additions to our knowledge of its properties, and there are numerous applications for the 250 compounds of the metal, an account of which we omit from want of space and may recur to hereafter.

[For the Scientific American.]

THE CENTURY PLANT.

BY JOHN RAMSAY GORDON.

The *Agave*, or *Caretas*, is one of the genus of plants known to botanists as the *Amaryllidaceæ*. The American aloe and century plant are names by which it is commonly known.

This plant grows abundantly in tropical climates, particularly in South America and the West Indies; it is called the caretas in the French colonies and in some of the other adjacent islands. The name, agave, is derived from a Greek word signifying glorious, which, I suppose, was given to it on account of its gorgeous appearance when in bloom, combined with its majestic growth; and, it seems, indeed, an appropriate one.

Though not aware of the origin of its French name, I believe it is mentioned by the celebrated writer, Pierre L'Abbat, in his description of the Antilles. Century plant is, I think, an incorrect name for it; of this I shall say more hereafter.

The agave, or tree aloe, in its entire appearance resembles very much the medicinal or shrub aloe; but, unlike the latter, it sends out but one stalk, and each leaf is rolled up lengthwise in itself when small; it is of a dark green color when in its youth, that hue changing to an olive shade with the decay of the plant.

The leaves of it are of a blade-like form, all growing from one base, near the ground; from the center of them there projects a stalk, which attains a hight of twenty feet, and sometimes more; this stalks grows perpendicularly, and is tolerably straight; from the stalk, there grow branches, which resemble the arms of the old style of saloon candle-stick. These branches bear flowers on attaining maturity, and afterwards seed pods appear on them. Though the entire plant is of a pulpy nature, it is nevertheless strong and durable. Some persons have asserted that it attains the great age of one hundred years, hence its name of century plant; but, I think, that this is hardly possible, as its roots are seldom firmly fixed in the soil where it grows, which in general is of a rocky nature. The stalk and branches become ligneous, or woody, before decay. The leaves are composed of a quantity of fibers or threads arranged longitudinally, which are covered and united by a greenish pulp, and the whole is inclosed by a substance resembling parchment. These blades are extremely sharp at their ends, and, at their edges, are provided with a series of small acute thorns, extending from the heart of the plant to the point of the blades.

When the agave is in bloom, the appearance of it is rather imposing, and the perfume which it emits is equal in effect to the night blooming cereus or any other essence of the toilet, and birds and insects gather about it in numbers to suck the nectar from its flowers. There are daily to be seen, also, innumerable swarms of bees gathering their food. One species of the trochilus, or humming-bird, known in the West Indies as the doctor bird, frequents, too, the localities where the aloe is to be found; and I have seen it with its plumage of brilliant hue, fluttering its tiny wings, and, while suspended in air, sipping its luscious draft of nectar.

I have before remarked that it has been stated that the plant attains the age of one hundred years; were it possible that this could be, I can safely affirm that the poor century plant would not stand one day after some jolly follower of Neptune had set his eye upon it.

Sailors! What will they not conceive? One Sabbath evening—the sailor's vacation—I watched a number of men who had provided themselves with axes, making an attempt to secure one of these plants, which they could not accomplish without cutting its surrounding leaves; and, as I was desirous of knowing what use they would make of it, I approached and questioned them. One of the men informed me that they made razor strops of the stalk, and that it furnished tolerably good ones too. It was cut into lengths of three feet in order to be portable, and at leisure it would be cut into the desired form of razor strops.

The name, caretas, applied to this plant by the French colonists, is very familiar to me as it is that which is employed in the island of St. Thomas whence I hail.

It seems to me that the caretas could be rendered very serviceable in several ways; and I think that it would furnish very good rope, as the fiber which exists in the leaves of the plant, when spun, makes strong cord; in fact, it is employed by the South American Indians for this purpose, though not to any great extent on account of the want of machinery necessary for the manufacture of it. I believe that it is also converted into medicine by the natives of South America and the West Indies.

Louisiana State Fair.

The fourth grand State Fair of the Mechanics and Agricultural Fair Association of Louisiana, will be held at New Orleans, in April of this year, commencing Saturday, the 23d, and continuing nine days. The Fair will be held on the extensive grounds of the Association in the above city, and a greatly enlarged list of premiums is offered. Visitors and exhibitors are invited from every section of the country. It is announced that railroads, steamships, and other transportation lines, will carry exhibitors and their wares at half price. The Secretary of the Association is Mr. Luther Homes, who may be addressed by parties wishing further information.