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(Illustrated articles are marked with an asterisk.)

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THE SCIENTIFIC AMERICAN SUPPLEMENT.

No. 308,

For the Week ending November 26, 1881.

Price 10 cents. For sale by all newsdealers.

THE FONTAINE LOCOMOTIVE.

A short time since there appeared in the SCIENTIFIC AMERICAN SUPPLEMENT (No. 305, November 5) several illustrations of the new type of locomotive engine devised by Mr. Eugene Fontaine, accompanied by a letter from Mr. John Ortton, Mechanical Superintendent of the Canada Southern Railway, describing the construction of the engine and the behavior of engine No. 1, in regular service on that road.

Referring to Mr. Ortton's communication and the testimony of the engineer in whose charge that engine and engine No. 3 had been run, we said: "From the evidence thus furnished it seems to be abundantly established that the Fontaine locomotive marks a long stride forward in the direction of speed and economy in railway service."

This recognition of the apparent importance of the changes in locomotive construction introduced by Mr. Fontaine has greatly displeased the *Railroad Gazette;* and in a long article on "The Fontaine Fallacy" it seeks to demonstrate the incapacity of the Fontaine locomotive to do the work and attain the speed accredited it by those who have witnessed its operation, and at the same time the incapacity of the SCIENTIFIC AMERICAN to correctly estimate the value of the evidence furnished as to the practical utility of the improvements it embodies. This would-be demonstration is fortified by a column of diagrams which lack only pertinence to the questions at issue to be very convincing. Admitting the correctness of the *Gazette's* argument, but one inference is possible, namely, that our worthy contemporary is talking about some other engine than the real Fontaine engine, which has been doing for months the very things the *Gazette* so elaborately proves to be impossible.

We are concerned not with Mr. Ortton's or any other man's theories, but with the actual behavior of the new engines on the road. The inventor claims that by a better plan of construction and method of applying the power to the drivers he is able to secure greater speed with a given consumption of fuel, or equal efficiency with less fuel, in comparison with other engines of the same size.

Mr. Ortton says that in practical service the new engine amply sustains the claims of the inventor; and Mr. Ortton's testimony is confirmed by that of Mr. W. P. Taylor, General Manager of the Canada Southern Railway, as will be seen in Mr. Taylor's letter printed at length in another column. On the basis of the actual performance of engine No. 1, Mr. Taylor pronounces it a perfect success in saving fuel as well as in developed power and speed. Mr. Taylor continues: "The engine has been running for several months on our road in freight and passenger service. A test was made with her against one of our best Baldwin engines, with the same sized cylinders, running on regular passenger trains. An accurate record was kept of the fuel consumed, which shows that the Fontaine made an average of fifteen miles more to a ton of coal than the Baldwin engine doing the same amount of work."

Touching the capacity of the engine for speed, Mr. Taylor specifies time and circumstance and witnesses (including railway officers of national reputation), proving the ability of the engine to haul a "good sized train a mile a minute without difficulty." Using from 25 to 40 per cent less fuel than other engines of the same size, the Fontaine, Mr. Taylor says, "can perform the same service and has greater speed," either for passenger or freight service.

Until the *Gazette* has successfully impeached the testimony of Mr. Taylor, Mr. Ortton, and others, touching the actual behavior of this engine, it is obviously a little unfair, not to say injudicious and beside the question, to declare offhand (and evidently without taking the trouble to go across the river and look at the machine) that the inventor "seems to sincerely believe that he is able to get what in the West they call a 'twist' on the action of mechanical forces, and that he gets more power out of the cylinders of his engine than ever goes into them." It is worse than injudicious to add, as the *Gazette* does: "Under this mistake he [the inventor] is spending his own money, which is unwise; but what is worse is that the oldest and most widely circulated scientific paper in this country, by corroborating the erroneous theories which have been advanced concerning the engine, may induce other people to spend money on a device which the first and fundamental principles of mechanics should show to be irrational."

Repeating that we are concerned not with Mr. Fontaine's theories, actual or hypothetical, but with the practical performance of his engine, the SCIENTIFC AMERICAN persists in having a higher respect for the results of Mr. Fontaine's alleged irrationality and unwisdom than for the critical acumen of the *Gazette*. The question is not as to the possible performance of a theoretical engine, but what a real engine does.

After the "impossible" has been accomplished it usually turns out that the argument which established the supposed impossibility is found to be somewhere defective. Usually, too, the error is found to lie not in the logic of the argument, but in its inapplicability to the case in hand. That the flaw in the argument of the *Gazette* is of this nature is evident from its comparison of the Fontaine locomotive to the Keely motor, and its assertion that those who accept the performance of that locomotive as evidence of its value "are inclined to believe that Mr. Fontaine has made a 'corner' on the law of gravitation and the conservation of energy."

The *Gazette's* mistaken idea of the Fontaine locomotive may rightly be comparable with Mr. Keely's mythical invention; but the real engine, which has proved its capacity to haul a seven car train at a rate exceeding a mile a minute, and to handle freight trains as satisfactorily as much larger engines of the old type, is manifestly quite another thing.

It is easily possible that under the varying conditions of railway service, particularly as roads are now made, the Fontaine locomotive may not in all respects come up to the expectation of the inventor and his friends; it may not, for instance, accomplish a speed of ninety miles. Nevertheless, what it has already done, if human testimony is worth anything, justifies the position taken by this paper, that it marks a notable advance in locomotive construction, and that—to repeat our own words—"if experience shall confirm the promise held out by the performance of the engine now on trial," the new locomotive "must materially increase the economy of railway service." As yet we have seen no adequate reason for doubting the probability that the future behavior of the engine will confirm the record it has already made.

THE POSSIBILITIES OF THE COTTON INDUSTRY.

At this time less than one-tenth of the superficial area of the Southern States is under cultivation. The late census report shows that less than a third of the cultivated area is devoted to cotton. Under more skillful cultivation it is not improbable that one third of the land now devoted to cotton would produce the entire crop of the present day. The possibilities of increasing the yield of cotton in the South are, therefore, practically unlimited.

Is there any risk of raising more cotton than can be marketed?

The census of 1880 shows that we had then 10,700,000 spindles. The product of only 700,000 spindles was exported, the rest going for home wear. The State Department has at Atlanta specimens of fabrics, prices, etc., from all parts of Asia and Africa. Ninety per cent of the Chinese, the largest body of cotton-wearing people in the world, are clothed with cloth that is manufactured in the primitive way, without machinery. Almost all Asia is clothed in the same way. Cotton manufacturing machinery has hardly touched this immense demand. Mr. Atkinson is authority for the statement that when drills can be sold in New York or Boston at seven cents a yard, they can be sold cheaper in Asia than the native hand-made goods. When middling cotton is nine cents a pound in New York, drills can be made and sold profitably at seven cents a yard.

The question of unlimited extension of cotton manufacture thus obviously hinges on the possibility of producing cotton at an average price of nine cents at the mill. It is believed that much more than the difference between nine cents and the market price for cotton is habitually lost by Southern planters through careless handling. It is reported that a farmer recently brought to the cotton fair at Atlanta a lot of cotton in the seed which he would willingly have sold to a factor for ten and a half cents a pound (lint), the market price on that day. The manufacturer examined it and gave him sixteen cents a pound. In other words, the intermediate steps between planter and manufacturer cost the planter five and a half cents a pound. The greater part of this five and a half cents loss is caused not by commissions, insurance, storing, and shipping—all these are comparatively small, and will compare favorably with similar costs in handling other produce—but by the universally careless method of handling the cotton. Careful picking from the field, careful ginning, secure baling so as to prevent soiling and to keep out sand, and a careful assortment of the different grades saved five and a half cents a pound.

It is not to be supposed that the extra care in this case cost the farmer anything like five cents a pound, or roughly, half the entire cost of his cotton. The desired price, nine cents a pound, mentioned above, is for cotton as it usually reaches the mill. It would be worth several cents more if in proper condition, increasing correspondingly the farmer's profit without enhancing at all the cost of the cloth.

From these figures it would seem easy for our cotton planters to increase their profits and at the same time furnish our manufacturers with cotton at such a price—improved condition being considered—as would enable them to command the markets of the world, even in competition with the hand work of savages. Of course with possible improvements in processes and appliances the margin of profit to the cotton planters of the South may be still further widened.

THE CAUSE OF FAILURE OF STEEL BOILER PLATES.

Steam Boiler Notes in the SCIENTIFIC AMERICAN of August 20, contain an account of the failure of Russian war yacht's steel boiler shells, and an abstract of a report on their behavior by Mr. W. Parker, chief engineer of Lloyds' Register, which was read before the Institute of Naval Architects of England. These plates, after having passed through the various tests required by the English authorities, gave way in a most astonishing manner under the official hydrostatic test after the boilers were completed. The analysis of the metal given by Mr. Parker showed a want of uniformity in their chemical composition. The papers lately read before the British Iron and Steel Institute shed more light on this important subject.

The paper of Mr. W. D. Allen, on the use of a mechanical agitator in the manufacture of Bessemer steel, shows that, in addition to the bubbly conditions of the ingots arising from confined gas generated by the admixture of the spiegeleisen or ferro-manganese to the decarbonized iron, there are veins or streaks of metal of different qualities and composition running in all directions through the mass, which are invisible to the eye, but manifest themselves in the physical properties of the finished products.

This is illustrated by an imperfect piece of glass, which shows veins and striæ arising from different densities of the composition; also by mixing painter's colors of different hues and densities. Lampblack and white lead, as an exaggerated example will not form a uniform resultant gray without much stirring. It is alleged that such is the case with spiegeleisen and decarbonized iron unless it is agitated and thoroughly mixed before being poured into the ingot mould.

In support of the theory that there is a difference in the chemical composition of the ingot before rolling into the finished form, we abstract from a paper read by Mr. G. J. Snelus at the same meeting, the entire proceedings of which we find in the *Ironmonger*. Mr. Snelus says: "At the last meeting of this Institute, in the discussion of Mr. Parry's paper, Mr. Stubbs announced the remarkable fact that he had discovered that the 'cast steel ingots' could not be strictly said to be homogeneous, and that a 'redistribution of the elements took place during solidification, the carbon, sulphur and phosphorus going to the part of the ingot which remained fluid the longest, so that the center of the ingot became the most impure.' Some years ago Dr. Percy suggested to me the desirability of ascertaining whether the spiegeleisen became thoroughly diffused in an ordinary Bessemer charge, and, to test the question, I analyzed the first and last ingots from a charge, and also the top and bottom of an ingot."

At the first series of experiments, which were upon small ingots, Mr. Stubbs' theory could not be established, but on repeating them upon large ingots, different results appeared.

After the spiegeleisen had been added the blast was sent through for nearly a minute to assure a thorough admixture. Slices were taken from this ingot twenty-one inches from the top and four inches from the bottom. The samples were exhibited at the meeting, the bottom one said to be sound, while the top one was spongy, which is in accordance with every foundryman's experience. But the important feature is the difference in the chemical composition. There was more than double as much combined carbon, and more than four times as much sulphur and phosphorus in the upper section as there was found in the lower section, while nearly the same difference existed between the center or axis of the ingot and the corners, as shown by analysis of successive drillings made on a diagonal line across the slip which had been cut horizontally from the prismatic ingot.

"These results," says the paper, "confirm the molecular interchange discovered by Mr. Stubbs in large ingots, and show that carbon, sulphur, and silicon become concentrated in those portions of the ingot that remain fluid the longest, leaving iron and manganese in excess in the portions from which they have liquidated."

The paper also says "the difference in hardness was most marked, rendering it difficult to cut the top slices near the center, while the bottom cut quite easily."

Now, it seems strange that Mr. Snelus should argue "that the singular molecular change does not afford an explanation of the peculiar behavior of the Livadia's plates." What, then, is the explanation? It is certain the plates were not homogeneous, if we are told the truth about their behavior, and the extreme care that was taken by the firm who made the boilers in annealing and reannealing them after punching the rivet holes. An engineer who has had experience with vicious workmen might fairly suspect that there is "a nigger in the fence."

It is hoped that our English neighbors will ferret him out, or else we cannot feel quite safe in the use of plates made from large ingots of soft steel. Our own steel makers have been more fortunate, but as the size of ingots increases there is danger that they also may get caught.

STEAM BOILER NOTES.

A boiler in Davis & Jones' portable steam sawmill, near Coalton, Jackson County, Ohio, exploded November 2. John Davis, one of the proprietors, was fatally injured, and David Griffiths was seriously injured.

It is a significant fact that in this country more boilers explode in establishments that use light fuel than in any other class of manufactories. In the year 1879 one-third of all the disastrous explosions that were published were in sawing and other woodworking mills that use their light refuse for fuel, and in 1880, 28 percentum of the unusually large total of explosions for that year were in this class of mills. It is probable that this results mainly from neglect of the safety va ves, coupled with the great, sudden, and oft repeated changes of the temperature of the boiler shell, the result of careless, excessive, and irregular firing, and perhaps the use of ice-cold feed water. The effect is violent contractions alternating with expansions of the parts of the boiler that are exposed to cold currents of inflowing air when the fire doors are opened, which occurs in this class of boilers perhaps ten times as often as in those that burn hard anthracite. The same parts of the boiler are, when the fire doors are closed, exposed to the greatest heat of the brisk fire, and a sudden explosion follows.

The great number of thrashing engine explosions that occur every autumn tends to confirm this theory of the cause of deterioration, from which no doubt many disasters arise.

It is also a fact that portable sawmills and thrashing machines are generally in the hands of log drivers or farmers, who do not think it worth while to have their boilers inspected or to employ an engineer, even when adjustments of the engine are needed, believing that they can "fix her up," and that "she" will safely wear out as their boots or their carts and draught chains do.

Builders of portable engines sometimes, nay often, sell their machines to inexperienced persons as absolutely safe from explosion, citing some feature new to the buyer or disguised by some change of outward form of the boiler, which render it entirely unnecessary to know anything about steam or the steam engine in order to use them with perfect safety.

"Build your fire, give her plenty of water, and carry all the steam you need, she's fixed to take care of herself," is the parting instruction to the enterprising huckster as he drives away with his new purchase, the *Excelsior* or the *Gamecock*, from the works of the equally enterprising builder of non-explosive portable engines. Those who know that there are twenty ways for that machine to get out of fix, a dozen of which relate to the safety valve and the steam gauge, do not care to read the details of the inevitable sequel of such an adventure.

A RAIN OF SPIDER WEBS.

In the latter part of October the good people of Milwaukee (Wis.) and the neighboring towns were astonished by a general fall of spider webs. The webs seemed to come from "over the lake," and appeared to fall from a great height. The strands were from two feet to several rods in length. At Green Bay the fall was the same, coming from the direction of the bay, only the webs varied from sixty feet in length to mere specks, and were seen as far up in the air as the power of the eye could reach. At Vesburg and Fort Howard, Sheboygan, and Ozaukee, the fall was similarly observed, in some places being so thick as to annoy the eye. In all instances the webs were strong in texture and very white.

Curiously there is no mention, in any of the reports that we have seen, of the presence of spiders in this general shower of webs. It is to be hoped that some competent observer—that is, some one who has made a study of spiders and their habits—was at hand and will report more specifically the conditions of this interesting phenomenon.

Quite a number of notable gossamer showers have been reported in different parts of the world. White describes several in his history of Selborne. In one of them the fall continued nearly a whole day, the webs coming from such a height that from the top of the highest hill near by they were seen descending from a region still above the range of distinct vision.

Darwin describes a similar shower observed by him from the deck of the Beagle, off the mouth of La Plata River, when the vessel was sixty miles from land. He was probably the first to notice that each web of the gossamer carried a Lilliputian aeronaut. He watched the spiders on their arrival and saw many of them put forth a new web and float away.

The behavior of the spiders when setting out upon their aerial voyage has been minutely described by a recent English observer. The shower observed by him occurred in September, 1875, after a thunderstorm without rain. He says:

"About ten A.M. I noticed small spiders running over my coat-sleeves, and had to brush off several trails of gossamer web. Looking round I found that brick walls, houses, branches of trees, etc., had these webs dangling from them, and that other gossamer webs were continually falling from above and adding to the accumulation. By mid-day a long fence was festooned from point to point of its triangular railtops with a ribbon-like ladder of gossamer; and this was growing broader and broader as the tiny creatures kept running along this ladder, each increasing the breadth by adding its own contribution of another silken thread.

"On examining next an iron palisading near, I found it in a similar condition, with the tops of the iron spikes connected by a vibrating silken ladder of gossamer, in some places nearly an inch broad. All along this ladder the little strangers were running in an excited and hurried manner, as if they had lost their way and had got into a strange country. Some, in traveling over their improvised road, made mistakes, and got into bordering webs of the garden spider, where they were speedily devoured. About 1 P.M. the clouds cleared off, the sun shone out, and I noticed that some of the spiders had begun to reascend into the atmosphere. They might have commenced this reascension earlier; but on observing that some *were* reascending all my attention was devoted to single spiders, and this is what I saw: Fixing my eyes upon one of them, I observed that as it left the gossamer pathway it selected a clean spot on the iron railing, and gathering its limbs closely together it projected from its spinnerets several threads, which expanded outward and stretched upward from nine to twelve inches. Then this parachute seemed to show a buoyant tendency, and suddenly the tiny creature left hold of the iron rail, or was lifted off it, and quickly 'vanished into thin air.' One after another I closely watched, with the same general result; though once or twice when the spider left the rail it floated for a few seconds in an almost horizontal direction, prior to changing it for an approximately vertical one. They, however, disappeared from sight so quickly that the angle of ascent could only be guessed at. This, however, may be set down, as the rule, at from ninety to one hundred and twenty degrees."

The object of these spider migrations, if they are migrations, and the reasons for the fall of the webs at a time when the spiders are able to ascend at will, are mysteries which are as hard to explain to-day as they were in Chaucer's time, or in that mythical period from which comes the ancient nursery rhyme:

"'Old woman, old woman, old woman,' quoth I,
'O whither, O whither, O whither so high?'
'To sweep the cobwebs out of the sky!'"

From the strength of the webs reported in the recent Western showers there would appear to be a doubt as to the spider which produced them. They seem to have been too strong for gossamers. Perhaps the shower may have been due to an unusual excursion of the more familiar geometric spider, this species having the same power of shooting out webs which float upon the air and sometimes serve as an airraft for the producer. The natural history of spiders is comparatively an unexplored field for observation; and it is possible that many species emulate the wandering gossamer spider, and betake themselves to the air when occasion serves.

EXPERIMENTS WITH THE GOVERNMENT TESTING MACHINE.

A pamphlet lately published by Colonel T. T. S. Laidley, U. S. A., contains an interesting account of experiments made with the great United States testing machine at the Arsenal, Watertown, Mass. The experiments were made upon thick, hollow, cast iron cylinders similar to cannon, some of them lined with coiled wrought iron, and some with bronze tubes, and in competition with them others lined with thin copper tubes. It was held by the author of the paper, as an officer of the Ordnance Board, that the simple hollow cylinder of American cast iron is stronger to resist internal pressure than composite cylinders made upon the plan proposed for the conversion of old 10-inch smooth borers into 8-inch rifled guns. The object of the thin copper lining used by Colonel Laidley is, in practice, to prevent the gases resulting from the burning of the charge from penetrating the incipient cracks in the bore that are developed by continued firing. These gases have thus "an enlarged surface to act upon to burst the gun."

The cylinders experimented on had a uniform diameter of 11 inches and a bore inside of the tubing of 3·3 inches. Of the cylinders made upon the composite plan, those having the iron lining had had a section of about 3 inches of cast iron and 0·9 inch of coiled wrought iron, in thickness on coil side of the bore. Those having the bronze lining had about 3·4 inches of cast iron and 0·5 inch of bronze, while those lined with thin copper had all but 0·1 inch of thin section of cast iron, and, as regards strength to resist internal pressure, they might be considered as cast iron with loose copper veneers. These cylinders, having a length of bore of 16½ to 17⅛ inches, were tested by pressure upon a filling of cold beeswax by means of a nicely fitting copper follower and a loosely fitting steel piston, which, having been put into the cylinder in the order in which they are here named, the whole was placed in the immense testing machine and the piston forced in. The wax was compressed 11·6 per cent under a pressure of 60,000 pounds per square inch, but the yielding of the cylinders before bursting allowed a shortening of the column of wax something more than that fraction of its length.

The veneered or copper lined cylinders burst at an average pressure of 93,400, the bronze lined cylinders at 84,500, and the coiled iron lined cylinders at 78,000 pounds per square inch. They burst at the above roughly stated averages with loud reports which were heard at considerable distance, and the fragments, not exceeding three or four in any one case, were thrown with such force as to crack a five-eighths inch wrought iron casing that surrounded them.

Colonel Laidley in his report says: "The strength of the different kinds of cylinders is in direct proportion to the area of cast iron in the longitudinal section through the axis of the cylinder." And his conclusion is: "That any system of gun construction based on this plan of conversion will be found to be defective in principle and in the end expensive."

It seems to be expensive in the beginning, as the report shows that about $1,700 will pay for an 8-inch rifled cast iron gun of the exterior pattern of the 10 inch Rodman smooth bore, while the weaker converted 8-inch guns recently made cost $2,050 each.

The other officers of the U. S. Ordnance Board seem to reject the conclusions based on these experiments, the board deciding "that any favorable consideration of the question of the use of cast iron (pure and simple) in gun construction would be a step backwards."

To an outsider it will not appear, from the report, that "pure and simple" cast iron is indicated by these experiments, but new cast iron guns lined with thin tubes "sufficient to act as gas checks and exclude the gas from all cracks that may be formed in the course of th: firing."

Moreover, it is by no means certain that a sound cast iron surface of the bore is not penetrated by the gases, and that a proper gas check lining would not prevent the inception as well as the subsequent enlargement of cracks. The members of the board, however, having probably committed themselves, upon such information as they previously had, to the composite plan, do not approve of experiments with gunpowder upon *small* cylinders, as is now recommended by Colonel Laidley.

The pamphlet contains photographs of the broken cylinders and a reply to the remarks made by the Ordnance Board. We commend it for perusal to all who are interested in progress in gunnery.