Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, NEW YORK.

TERMS FOR THE SCIENTIFIC AMERICAN.

One copy, one year, for the U. S., Canada or Mexico	$3 00
One copy, six months, for the U. S., Canada or Mexico	1 50
One copy, one year, to any foreign country belonging to Postal Union	4 00

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NEW YORK, SATURDAY, JANUARY 18, 1896.

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(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 1046.

For the Week Ending January 18, 1896.

Price 10 cents. For sale by all newsdealers.

THE ADVANTAGES OF THE INDUCED OVER THE FORCED DRAUGHT SYSTEM.

It has been abundantly proved that the excellent steam-raising qualities of the forced draught system are obtained at the cost of a very serious strain upon the material and fittings of the boiler itself.

A certain well known naval authority has characterized it as "an invention of the evil one," and it is a fact that many of the later ships that have been built in European navies have been put through their natural draught trials only, the naval boards not caring to subject the boilers to the severe ordeal of a forced draught trial.

Until very recently it has been a common experience for ships in the British navy to have their trial trips brought to a sudden close on account of leaking tube ends in the tube plate.

There are many fine ships afloat in the navies of the world to day which are provided with all the appliances for forced draught, and yet dare not make use of it except under the pressure of extreme emergency.

There is a further objection to this system, arising from the fact that it necessitates the use of the closed stokehold, in which the firemen work under the air pressure that is set up by the fans; all communication with the outside world being shut off by means of airtight doors. It has been sought to escape these difficulties by substituting induced for forced draught. Induced draught is similar in its action to natural draught, which is the kind that takes place in any domestic or factory flue or chimney.

Broadly speaking, induced and natural draught are the result of a vacuum which is produced at the bottom of the uptake of a boiler, in the rear of the furnace; forced draught results from an excess of pressure of the air in front of the furnace over the atmospheric pressure.

The two expedients which have been adopted in place of forced draught are to be seen on the United States cruiser Brooklyn, in which the natural draught is increased by the employment of smokestacks of exceptional height, and in the British ship Magnificent, where the same result is gained by placing a fan 8 ft. 6 in. in diameter at the bottom of each uptake. In both cases the rush of air through the furnaces is promoted by creating a vacuum at the rear of the furnaces.

The system adopted on the Brooklyn has this advantage, that it saves the weight, first cost, and running cost of the auxiliary engines for driving the fans as used on the Magnificent. Moreover, there is a considerable saving of steam—a weighty consideration in modern war ships, where there are so many auxiliary engines for pumping, lighting, and refrigerating purposes, that already use up a large amount of the total steam supply.

The use of abnormally lofty smokestacks has been tested in the merchant marine in the steamship Scot, which runs from Southampton to the Cape. Her smokestacks measured 120 feet in height from the firebars. Those of the Brooklyn are to exceed this, and the application of the system to this first class cruiser will be watched with great interest by the naval world.

THE ACCELERATION OF RAILWAY SPEEDS.

The question is frequently asked as to how fast a passenger train can be run. The various conditions which affect the making of railroad records are intimately correlated, some being found in the engine, some in the train, and some in the roadbed and track upon which they run.

Taking the standard fast train of to-day as represented by the Empire State Express on the N. Y. C. and H. R. R. R., it can safely be said that when in 1893 it ran for a short distance at over 100 miles an hour, it was for that short spurt traveling up to the very limit of the possibilities of our present system of railway locomotion. The whole tendency of the age toward time saving makes it certain that, before the twentieth century is far advanced, the traveling public will be clamoring for a vastly increased rate of speed over present rates. The experience of the past teaches that when the patrons of a wealthy transportation company, whether on sea or land, demand a faster service—and are willing to pay for it—they usually get it.

We state a few suggestions as to the proper lines of investigation to be pursued in order to effect such improvements.

The Track.—This must be straightened as much as possible. On a tangent the whole tractive effort of the engine is available on the drawbar of the train. On a curve the effort is split into two components, one of which is expended against the outer rail of the curve, while the other is available to haul the train. The component which is lost in the outer rail increases with the increase of the sharpness of the curve; and vice versa, the more we can straighten out or "ease" the curve, the less will be the loss from this cause.

Grades must be Lightened.—The resistance due to grade is too obvious to call for elaboration here.

Heavier Rails must be Provided.—No amount of care can keep a roadbed in perfect level. The storms and frost of winter and the drought of summer will develop soft places. If the steel rail be deep and heavy, it will bridge these weak spots, and preserve the general level. The load of the train is concentrated at certain points of contact, where the steel tire meets the steel rail. The ideal track will distribute this concentrated load as evenly as possible to the widest possible surface of roadbed. For a speed of 75 miles an hour, 100 to 125 pound rail should be laid upon ties 6 inches by 10 inches by 10 feet long.

Better Rail Joints will be Required.—The joints are to-day by far the weakest point, even in our best tracks. The perfect joint should be as rigid, and yet as elastic, as the rail itself. To get the required depth for stiffness it should be of the sub-rail type, associated with some form of angle bar to secure alignment. With the introduction of 60 foot rails, the number of joints will be reduced to one-half, and some of the expense thus saved could be well spent in improving their quality. Whenever it is possible to hear the "click" or "hammer" of a joint, we may be sure that a certain amount of the momentum of the train is being absorbed at that point. A perfect track involves a silent joint.

Engines.—The fast express engine of the future will be a single driver. It has been abundantly proved that 20 tons on one pair of drivers will give all the adhesion necessary to haul an express train of to-day. Engines with single drivers are not troubled with slipping of the wheels, except occasionally in damp weather. At such a time steam sanding apparatus gives the drivers the necessary adhesion. Where loads are heavy, as in the slower and heavier passenger trains, or in freight trains, it becomes necessary to couple on an extra pair of wheels.

The Philadelphia and Reading engine is doing better work with a single driver than its sister engines of the four-coupled type. The single driver engine is easy to counterbalance and the internal friction is largely reduced.

The drivers will be of not less than 7 or 8 feet diameter, and running as they will on 100 to 125 pound rail they can be safely loaded up to 25 tons. This will give sufficient adhesion for 20 or 21 inch cylinders; which, with a steam pressure of 200 to 225 pounds and large steam ports, would give us a locomotive of very large high speed hauling capacity.

Cars.—It is in the reconstruction of cars that the greatest gain will be made. We have for many years been of the opinion that the weight of a Pullman car was out of all proportion to the number of people it carried. In a train made up of Pullman cars, the engine has to haul not less that $1\frac{1}{2}$ tons of dead load for each passenger carried. On the race track the bicycle carries its load at average railroad speed on a deadweight basis of 20 pounds to the passenger. One hundred and fifty times as much deadweight to be carried per passenger on a railroad as on a bicycle. Making all allowance for the shelter and convenience of car travel, there is evidently something wrong. The weight of the car is excessive, and it is the outcome of the rough and dangerous condition of the earlier railroads, and of the competition among the builders to excel in providing a luxurious "palace" car. The car was made heavy in order that it might ride easily on rough track and hold together when it jumped the track; it was loaded down with heavy plate mirrors, solid hard wood carving and moulding, and massive brass and plated work in the attempt to beautify it. The two causes have both disappeared. Our trains stay on the track and automatic signaling has done away with collisions. They can safely be built lighter. A better taste has been cultivated among us in the matter of decorations and fittings, and Pullman cars could be relieved of much silver plating and glass plate, and yet be made artistic and pleasing in their interior fittings.

The weight per linear foot of an express train could be greatly reduced by reducing the length of the individual cars. A car rests upon its two trucks in the same way as a bridge upon its abutments. Like the bridge, its weight per foot will increase rapidly with its length. Two forty foot cars would not weigh as much as one eighty foot car; and though there would be four trucks for two, they would be of very much lighter construction. Moreover, the distribution of the load upon double the number of trucks would cause it to haul with greater ease. The trucks of a 50 ton Pullman car depress the track by their excessive concentration of load, and are always running in a hollow or, as it has been well expressed, "climbing up hill."

The cars could be further lightened in their construction by the substitution of high grade steel for timber. The use of nickel steel for the floors and side trusses, with thin plating for sides and roof, would result in a light, but very stiff and strong car. By furnishing the interior with rattan or basket work chairs and lounges, such as are to be found on some lines today, a further saving of weight could be effected.

It is a mistake to claim that light cars ride roughly. On rough track they do; but on first-class track weight ceases to be at a premium.