SCIENTIFIC AMERICAN

ESTABLISHED 1845

MUNN & CO. - - Editors and Proprietors

Published Weekly at

No. 361 Broadway, New York

TERMS TO SUBSCRIBERS

One copy, one year, for the United States or Mexico.....$3.00
One copy, one year, for Canada..... 3.75
One copy, one year, to any foreign country, postage prepaid, £0 16s. 5d. 4.00

THE SCIENTIFIC AMERICAN PUBLICATIONS

Scientific American [Established 1845] .....$3.00 a year
Scientific American Supplement (Established 1876)..... 5.00 "
American Homes and Gardens..... 3.00 "
Scientific American Export Edition (Established 1878)..... 3.00 "
The combined subscription rates and rates to foreign countries, including Canada, will be furnished upon application.
Remit by postal or express money order, or by bank draft or check.
MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, MAY 18, 1907.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

A SPEEDY SOLUTION OF THE "BROKEN RAIL" PROBLEM.

We invite the attention of those who are interested—and who is not?—in the serious question of the increasing number of broken rails, to the somewhat lengthy article published elsewhere in this issue on that subject. It would be the sheerest folly to ignore or deny the magnitude of the danger which, under the existing conditions, threatens everyone who takes a journey upon our railroads. The State Railroad Commission of the most important State in the Union has taken official cognizance of this question; and unless the responsible parties take speedy steps to improve the quality of the rails, the subject is one that may well become the subject of Federal action.

The present conditions are intolerable. Rails have become so unreliable as to constitute a continual menace to the safety of the passengers. The daily papers are filled with accounts of this or that train that has been ditched; and in the majority of cases at the end of the telegraphic account is a brief notice to the effect that the cause was a broken rail. We have shown elsewhere that the deterioration in the quality of the rails is due to the inferior quality of the steel used in their manufacture, and that the inferior quality is due to two facts; first, that the ores of which the steel is being made contain a larger amount than formerly of an impurity which cannot be removed by the Bessemer process; and second, that the manufacturers are using a portion of the steel ingot from which the rails are rolled, which formerly, under the railroad engineers' specification, was rejected as scrap. The engineers claim that the broken rails come chiefly from that portion of the ingot which they used to reject, but which the mills are now incorporating. They also claim that if this portion of the ingot were rejected, it would be possible, in spite of the depreciation in the quality of the ores, to roll a rail which would stand fairly well up to its work. On the other hand, the manufacturers understand that if a one-third crop were used on the ingots, it would mean an immediate and very large reduction in their output, a reduction which, in view of the increasing demands for rails, they are unwilling to make.

Starting from the incontrovertible standpoint that the railroads ought to be provided with the very best and safest rail possible, it would seem that the only and perfectly proper solution of the difficulty would be to make the one-third crop, as requested; roll rails of the very highest character that can be secured under the Bessemer process; and, in order to meet the shortage of the supply that would result from these improvements in manufacture, to remit the duty on steel rails, until such time as the rail-making concerns shall have been able to build and set in operation sufficient Open-Hearth plants to supply the full demands of the country.

THE SUBWAY DEADLOCK IN NEW YORK.

The refusal of the Interborough Company to put in a bid for the new subways, and the failure of any outside bidders to manifest any interest in the question, brings the city face to face with what is perhaps the most serious problem with which it has been confronted in all its existence. Figures prepared by Mr. Rice, Chief Engineer of the Rapid Transit Commission, prove that, unless the work of building new subways be at once put in hand and vigorously prosecuted, the rising tide of population and travel will in a few years have so completely overflowed the lines of travel, that the daily activities of this, the second greatest city in the world, will be at a deadlock.

According to the Rapid Transit figures, as given by their Chief Engineer, the population of Manhattan and the Bronx by the year 1916 will be at least 3,170,000, and the total number of passengers that must be carried will have reached the enormous total of 4,454,800 a day. These figures are based upon the carefully ascertained statistics of the rate of growth of population and travel in the past two years, and Mr. Rice finds that the population of Greater New York has doubled itself every twenty-five years, and will probably double itself again by 1930. He states also that the total passenger traffic, as shown by ticket sales, is increasing at such a rate that it will probably double itself within the comparatively brief period of ten years' time.

From this forecast, which there is every reason to believe is well founded, the Rapid Transit Commission are satisfied that the following provisions must be made: Within the next five years there must be built subways as follows: In Brooklyn, two four-track subways operated with ten-car trains, providing for eight additional tracks crossing the East River, either by tunnel or bridge. For Manhattan and the Bronx, three four-track subways operated with ten-car trains. Within the second five years there will be required for Brooklyn two additional four-track subways, and three additional for Manhattan and the Bronx.

For a period of four years the increase in passenger traffic in Greater New York has been at an even rate of 63,000,000 additional passengers a year, but last year the increase rose to the enormous figure of 110,000,000, presumably as the result of the increased facilities afforded by the opening of the Subway. The increase in the population of Manhattan has been fifteen per cent in the past five years; but the increase of traffic on all lines during the same period has been at the rate of thirty-nine per cent; while in the last five years the increase in the number of long-distance passengers in Manhattan has been 108 per cent, although this last-named increase is not likely to be maintained.

We are satisfied, after a thoughtful perusal of the above estimates, coming as they do from an authority so well qualified to judge, that they are sufficient to warrant our opening statement, that the transportation problem is perhaps the most serious that has confronted the city in the whole period of its existence. The immediate solution lies primarily with the Interborough Company, and it is earnestly to be hoped that, although they are a strictly commercial corporation, and are naturally desirous of securing all the profits that are possible, they will bear in mind that, as regards the contract under which they secured the present Subway, they have been very liberally dealt with by the city, and in no respect more so than in regard to the advertising privileges. The city has shown its desire to meet the Interborough Company halfway in its recent proposal to permit that company to construct additional tracks on the Third Avenue and Second Avenue railways, if they will agree to construct the upper east side and lower west side subways under the terms of the present proposed contracts.

NEW USES FOR AN OLD DEVICE.—THE GYROSCOPIC RAILROAD TRAIN.

The recent very successful tests of Dr. Schlick's gyroscopic apparatus for steadying ships has evidently opened a new field of usefulness for an old device, which for many years was looked upon in no more serious light than that of an interesting scientific toy. Shortly after the first report of Schlick's invention, there came from Germany the announcement of another ingenious application of the gyroscopic principle, namely, its installation on board ship in place of the magnetic compass; and it will be within memory that the tests of this device, as carried out by the German navy, were reported at the time to have been highly successful.

Considerably antedating these two inventions was the appearance of the successful Obry steering gear for torpedoes, in which the tendency of the gyroscope to maintain itself in its plane of rotation was utilized to control the rudder of the torpedo and maintain the latter on a predetermined course. This is the most important improvement effected in the torpedo since the introduction of the hydraulically balanced piston to control the submersion rudders for holding the torpedo at a predetermined depth.

Not always, however, does gyroscopic action lend itself to useful purposes, and indeed, in its larger effects, where the rotating masses are heavy, it may sometimes set up stresses which are apt to be overlooked and may contribute to, if they do not actually cause, disaster. The SCIENTIFIC AMERICAN recently discussed the gyroscopic action of steam turbines in increasing the stresses in the frail hull structure of torpedo boats. The subject was brought up a few months ago by an English naval architect, who proved that in the case of the British torpedo boat whose back was broken when she was plunging heavily into a head sea, the gyroscopic resistance to a change of plane of the revolving parts of the turbine may have amounted to several tons, and that these stresses, being unrecognized at the time the boat was designed, may have carried the total bending and wrenching stresses beyond the limit of strength of the hull.

Another instance of unfavorable gyroscopic action was discussed at the time of the Woodlawn wreck, when it was suggested that the centrifugal force exerted against the outer rail may have been augmented by the gyroscopic resistance of the axles and wheels, and the armatures of the electric locomotive. We believe that no calculation of this effect was made at the time the locomotives were designed; and in view of the novelty of such an investigation, the oversight must be considered as entirely pardonable. Subsequently to the wreck, the problem was worked out, and it was found that the gyroscopic effect would add about five per cent to the thrust resulting from centrifugal action of the whole locomotive.

Judged by the extent of the benefits conferred, the use of the gyroscope for steadying ships promises to be the most valuable practical application to which it has been put. The device has received a strong indorsement from no less an authority than Sir William H. White, former Chief Constructor of the British Navy. In his recent paper read before the Institution of Naval Architects, he stated that, from personal observations, he was in a position to certify to the remarkable steadying effect of the gyroscope. These observations were made on board a vessel 116 feet in length and of 56 tons displacement, on which the gyroscope was fitted in a compartment ahead of the boiler room, the axis of the device being carried in a vertical plane. At the commencement of each test, with the flywheel running at 1,600 revolutions per minute, and the gyroscope clamped to prevent movement, the vessel was placed broadside to the waves, and a total arc of rolling of thirty degrees was recorded. Immediately the gyroscope was released and came into operation, the rolling was reduced to one degree, and the vessel was "simply subjected to heaving motion as successive waves passed by her." Sir William White considers that the gyroscope will be particularly useful on yachts and on passenger steamers employed on coasting and cross-channel services. He states that he has investigated this problem for typical vessels now in service, and feels confident that remarkable steadiness can be assured by the installation of gyroscopes of moderate size and weight, requiring comparatively small power for driving them. Because of the great size of modern ocean steamers and their consequent steadiness, the demands for such an apparatus are not so urgent; although steadying apparatus might be introduced to good effect even here. For warships, the possible applications of the device are numerous; and the advantages of securing a steady gun platform are already well known. The tendency, of late, to build warships of great metacentric height will probably tend to shorter periods of oscillation, and in correcting this tendency the gyroscope may be found to possess value.

Judged from the standpoint of its curious interest, however, it must be admitted that the most original proposal to apply the gyroscope to practical purposes is that of Mr. Louis Brennan, the inventor of the Brennan torpedo, who would use the device to maintain a full-sized railroad train in the vertical position while it is traveling upon a single rail laid upon the surface of the ground. According to the cable dispatches, Mr. Brennan's device appears, strange to say, to have had sufficient practical merit to warrant its rather lengthy exploitation under the auspices of the Royal Society of London, a model built on a scale of one-eighth full size having been shown in operation. It is, of course, a far cry from a model to a structure of the size and weight of a modern railroad train; and at the first blush it would seem as though the weight of gyroscopes of the size necessary to impart the required stability would be so great as to rob the invention of all practical utility. According to the inventor, the weight of the apparatus works out at only five per cent of the total load; or say, about three tons for a sixty-ton Pullman car. If this be the case, it is certain that the flywheel must be run at an enormous speed—a speed so high that it becomes a matter of speculation as to what kind of metal can be found to withstand the enormous centrifugal stresses that would be involved. Furthermore, it must be remembered that a failure of the rotating mechanism would mean the loss of all stability by the train; and that just here, in the unlikely event that the invention should prove to be mechanically practicable, would be a constant source of peril, which might well detract from its popularity with the traveling public.

Another difficulty which suggests itself is the action of centrifugal force upon the passengers in rounding curves at the 120 miles an hour speed proposed. The car would incline to the outside of the curve at an angle which would be the resultant of the pull of centrifugal force against the resistance of the gyroscope; but the living freight would be thrown even farther off the vertical. But perhaps the scheme involves the provision of some ingenious form of "pocket" gyroscope to be "carried conveniently" on the person; or it may be that the promoters are satisfied that those who would trust themselves to such means of travel already carry sufficient "wheels" in the head to secure all the desired gyroscopic effects.