repaid with the profit provided by contract for all expenses which they have incurred for transportation.

But if they judge best to effect new reductions upon the tolls, which do not correspond with any expense dependent upon traffic, they should we think be extended to all, because it is a veritable impost, which by its nature should be the same for all.

Far from opposing the differential tariffs as applied on account of the good market which they procure for certain freights, we reproach them, on the contrary, with rendering it relatively too dear for the majority of forwarders; what we contend against with all the energy of our conviction in the actual system, certainly is not the moderation of the taxes, but their elevation for the majority and the injustice which distributes the imposts of tolls precisely in the inverse ratio of the ability of those who have to pay them.

8. To prevent this injustice, and at the same time accounting to the great industrial interests for the economies which they alone have allowed them, it would suffice to determine in each particular case the value of reductions of expense resulting from the special conditions agreed upon for the freight, and to limit to this figure the maximum of *exceptional* advantages accorded to forwarders who accept them. Such should be the limit to assign to the differential elements of tariff.

Every reduction above this, falling then upon the tolls, should be made common for all freight of the same nature, whatever its importance, its production, and destination.

This rule, of an easy application, in its generality embraces, with the differential tariffs properly called the indirect tariffs, the international, special, and private bargains; but absolutely rejects the last class of tariffs or the tariff "*d'abouement*." In fact, the economy which such a condition procures for companies cannot be determined, since it cannot state precisely the quantity of merchandise assured to their traffic. Now to give the whole of its freight to the railroad, and obtain the same reduction, whatever the mass, is surely not to receive an equivalent for the economy it affords, but simply to receive a premium of the companies for uniting with them in the destruction of a rival interest.

(To be Continued.)

On Increased Brake Power for Stopping Railway Trains. By Mr. ALEXANDER ALLEN, of Perth.

From Newton's London Journal, August, 1860.

The subject of increased brake power, for stopping quick trains in a shorter distance than is at present practicable, has become of great importance, and the attention of railway companies has recently been specially drawn to it by the railway department of the Board of Trade, by whom a number of experiments were tried on brakes of engines and carriages; and a recommendation was made to the railway companies for carrying out a system of continuous brakes to the whole train. The subject was also recently under the consideration of a committee

of the House of Commons, before whom evidence was given on the causes of railway accidents; this evidence was in favor of increased brake power on the engine, if not too suddenly applied; for it was shown that no brake on the carriages could be applied quickly enough to prevent accidents.

The subject of this paper is a plan for obtaining increased brake power, by retarding the speed of the engine by means of a throttle-valve placed in the exhaust-pipe, which can be instantly closed to any required extent, so as to obstruct the exit of steam from the cylinders, the regulator remaining open; at the same time the exhaust steam is admitted to a small cylinder, the piston of which acts through levers upon a brake on the engine wheels.

In this arrangement, the spindle of the throttle-valve projects through the side of the smoke-box, and is worked from the foot-plate by means of a lever and a connecting-rod. The brake cylinder is 8 to 10 inches diameter. The exhaust steam is admitted into the bottom of the cylinder through a $1\frac{1}{4}$ inch pipe, provided with a cock, and acting on the underside of the piston, lifts the brake lever and presses the brake blocks against the wheels. The cock in the $1\frac{1}{4}$ inch pipe is worked from the foot-plate, by means of a lever turning loose on the spindle of the throttle-valve; the throttle-valve can thus be closed, without at the same time admitting the exhaust steam to the brake cylinder, while the latter can also be instantly applied in cases of sudden emergency. When the steam pressure is removed from the cylinder, the weight of the piston and lever draws the brake blocks back clear of the wheels; the brake cylinder being contiguous to the smoke-box, and the pipe leading to it short and open to the heat in the exhaust pipe, there is no risk of water accumulating in the cylinder to prevent the descent of the piston when the steam pressure is removed. The brake blocks being under the charge of the engineman and fireman, will be regularly adjusted by them.

The brake cylinder applies the brakes simultaneously to the leading and trailing wheels of the engine, and the driving wheels are at the same time retarded by the back pressure of the exhaust steam on the pistons, consequent upon the closing of the throttle-valve in the exhaust pipe; the pressure of steam in the brake cylinder is the same as the back pressure in the driving cylinders, both being regulated by the extent of closing of the throttle-valve. The power of the brake cylinder is limited, so as not to skid any of the wheels, in order to avoid wearing flat places on the tyres, and to produce the greatest effect in retarding the speed; a brake power of from 14 to 22 tons can thus be obtained by the steam brake alone. The brake power obtained by the use of the throttle-valve alone, retarding the driving-wheels of the engine, is equal to that of the tender brake, the regulator being open to the driving cylinders all the time. The application of the steam brake by the engineman may be followed immediately by that of the tender brake by the fireman, and the guard's brake in the van next to the tender; thus giving at once a greater brake power than has usually been applied in retarding trains, and diminishing the liability to accidents from want of sufficient brake power.

For the ordinary stoppages, the throttle-valve can be used to bring the train nearly to a stand, the tender brake being applied for the last few yards only; this will effect a great saving in the permanent way, tender, tyres and brake-blocks. By partially closing the throttle-valve, trains may be controlled to any desired speed in passing down an incline, while a great surplus of brake power is reserved in the steam brake cylinder, and the tender and van brakes, to bring the train to a stand quickly on the incline. In an experiment made with a gross load of 200 to 210 tons, down an average incline of 1 in 80, of 5 miles length, the train was controlled by the throttle-valve alone, from a speed of 30 miles per hour at starting, to 15 miles per hour down the whole incline. In approaching stations half the time may be saved by the joint use of the tender brake and the throttle-valve alone in the exhaust pipe, and a still further saving of time effected by also admitting the steam to the brake cylinder. By using the steam brake for ordinary purposes in place of the tender brake, there is less risk of heating and flattening the tyres, since the steam brake is so arranged as not to skid the wheels.

In this method of obtaining brake power from the engine, the speedy reversing of the engine valve gear from forward to backward gear is rendered an easy operation, whereby a further increase of retarding power is obtained; for the exhaust steam at the back of the driving pistons being compressed in the exhaust port by the closing of the throttle-valve, the pressure of steam inside the slide valves becomes equal to or greater than that outside in the steam chest, so that a balance of pressure is established, enabling the valves to be reversed instantly with perfect ease. The partial closing of the throttle-valve may be employed to prevent violent slipping of the driving wheels, which will revolve only in proportion to the quantity of steam allowed to escape from the exhaust pipe, and this may be regulated to any extent by the throttle-valve, which can be worked with greater ease and nicety than the regulator.

The retarding power of this steam brake was tested by the writer on the Scottish Central Railway. In the first two trials, only the throttle-valve in the exhaust-pipe was used, without the addition of the steam brake cylinder, thus retarding only the driving wheels of the engine by the back pressure of the exhaust; the third trial was made with an engine having the steam brake cylinder in addition to the throttle-valve.

From these experiments, it appeared that the retarding power produced by closing the throttle-valve in the exhaust pipe was fully equal to that of the tender brake; and the engine steam brake also produced an effect fully equal to the tender brake; so that, by employing both throttle-valve and steam brake in conjunction with the tender brake, the retarding power obtained was more than double that of the ordinary tender brake alone.

Mr. R. Morrison remarked, that he had seen some experiments upon a steep incline of 1 in 40 on the Edinburgh and Glasgow Railway, with a steam brake contrived by Mr. Paton, which gave a very power-

ful retarding force; the brake was applied to the leading and trailing wheels of a large tank engine having all the wheels coupled, and the pressure was produced by a steam cylinder communicating direct with the boiler. The action of the brake was very efficient, but he believed the principal objection to it was found to be the great shock caused by its sudden application, which often deranged the levers of the apparatus, and occasioned an objectionable concussion to the train.

Mr. Allen said that, with the plan of the throttle-valve in the exhaust-pipe, this objection was removed, as the pressure came on gradually by the gradual compression of the exhaust steam; and no objectionable shock was perceived beyond what was of course unavoidable in stopping a quick-moving train within a short distance: a train at a speed of 40 miles per hour was stopped in 150 yards upon a level, by means of the steam brake and tender brake, without any objectionable shock being produced.

For the Journal of the Franklin Institute.

Repairs and Renewal of the Roche-Bernard Suspension Bridge.
From a description given by M. NOYON, Engineer. Translated by
J. BENNETT.

PART SECOND.

(Continued from page 156.)

Correction of Camber of Platform.—The platform, in obedience to all the movements of the primitive suspension bundles, must consequently rise in its middle 0.55 ft., and its camber, which at the mean temperature of 20° Centigrade (68° Fah.) stood at 4.26 ft., would attain 4.92 ft. at —5° (23° Fah.), and would occasionally be at $4.92 + 0.55 = 5.47$ ft. Now, as the platform had too marked a rise in its primitive position, it seemed necessary to diminish the sagitta, so as to correct the effect of establishing the additional cable, as well as to remedy the inconvenience of the proximity of the cables and platform, with the chances of the yokes of the central part rubbing against the stringers of side-walks. It was accordingly reduced 0.88 ft.; so that the camber was never to exceed 4.59 ft.

To accomplish this, the suspension rods had all to be removed and their lengths changed. Some were shortened, others simply removed some rows towards the centre, and those lengthened which were to be hooked upon the new cables.

Advantage was taken of this circumstance in correcting a fault of 2.75 ins. of level which was found between the sides of the flooring. It would have been a long job by calculation, but a graphical method indicated in the *Annales des Ponts et Chaussées* (2d series, tome xx, p. 509) was used, whose correctness was fully confirmed in this new application.

During the removal and restoration of the rods thus corrected, the beams were suspended upon the cables by four strong tackles, two at each end, so that they could be raised and freed from the stirrups and