slight change in the force or direction of the current causes it to pass off in tangents, when it finds its way into some less turbulent eddy, calculated to give it rest.

The material for bars is often wholly absent where eddies prevail, which directs our attention towards a more remote cause of their formation, the furnishing of the material. This is done most extensively and almost wholly by freshets; the principal precaution, then, is a control over the head waters of the rivers by means of reservoirs, which will not only prevent the obstruction of navigation, but the destruction of an immense amount of property. We have now only to take a trip on the Mississippi to realize the wisdom of Mr. Ellet's plan of improving the Ohio River, which, if it had been done accordingly, it would be easy to see without an estimate, the inconsiderable sum it would have cost, compared with the expense of dykes, crevasses, and the property destroyed by the present freshet on the Mississippi, which would have been effectually prevented by the improvement of the Ohio alone.

Corpus Christi, Texas, April 30, 1858.

Sliding Friction. Diminution of Sliding Friction as the velocity increases, particularly in the Friction of Cars on Rails: Formula which represents this Diminution. By M. H. BOCHET.

The excellent experiments of M. Morin (performed at Metz in 1831 and 1833,) upon sliding friction, placed beyond all doubt the law previously announced by Coulomb, that within the limits and in the conditions of these experiments, the sliding friction was independent of the velocity and of the extent of surface, and varied only with the pressure and the nature and condition of the surfaces in contact. So that this friction could be represented by the formula $f = p \kappa$. Where p is the pressure upon the surfaces, and κ a coefficient, the value of which depends on the nature and condition of the surfaces. But in these experiments, the velocities varied only from 0 to 3 metres per second, and in the experiments of Coulomb it was still less. It might then be doubted whether, under very different conditions, (for instance, in case the velocities should vary from 0 to 25 metres per second, as happens on railroads, when the trains are checked and some of the wheels slide over the rails, and in many other cases,) the same law would continue to govern the friction.

The precise coefficient in the peculiar case of the sliding of car-wheels over the rails was also to be determined in the various conditions of the rails.

New experiments instituted for this purpose in 1851, by M. J. Poirée, showed, that at least in the case of the friction on railroads, and for velocities varying from 4 to 22 metres per second, the friction diminished as the velocity increased.

Again, M. Nap. Garella, and the author of this Memoir, made, in

1856, experiments on the stopping of trains upon railroads, the results of which led to the same conclusion. And again, the same fact is developed by the experiments on the stopping of cars by the shoe-brake, made by M. Poirée in 1856.

The author sought to discover the precise law, and the formula which would represent the variation of the friction with the velocity, at least in the particular case of railroads, and he thinks that he has succeeded, by the graphic mode and by a series of deductions, in showing that

this variation may be represented by the formula $f = \frac{p \kappa}{1 + a v}$: where

f represents the intensity of the friction; p , the pressure on the rails; κ , a coefficient depending entirely on the condition of the rails, (the tires of the wheels, and surfaces of the brakes, being of wrought iron like the rails.) (This coefficient is to be taken = 0.3, when the rails are at their maximum dryness: 0.25 when they are very dry: 0.2 when dry: 0.14 when they are wet.) v is the velocity: and a is a coefficient whose value depends principally upon the manner in which the sliding takes place, (whether direct, that is, the wheels sliding over the rails, or by means of a shoe.) This coefficient appears to vary very slightly with κ : but this variation, even if it were certain, would not be of sufficient importance to be taken into account. The values of a to be assumed (the variations being calculated in metres per second,) are 0.03 when the wheels slide directly on the rails: 0.07 when a shoe is interposed.

The author thinks that this formula is in sufficiently exact accordance with the experimental results of M. Morin: the term av becoming too small to affect the results at his velocities; he thinks, moreover, that when the resistance of the air is taken into account, the discussion of these results shows a commencement of the diminution of the friction with an increasing velocity. He believes, therefore, that this phenomenon is general, and that it may be expressed by the formula

above, or perhaps better by the formula $\frac{f}{p} = \gamma + \frac{k \gamma}{1 + a v}$. κ keeping

the values determined for it by M. Morin, as long as the condition of his experiments are kept, while the values of a , (and perhaps, sometimes of γ), must be determined in the different cases of slipping.

Certain facts stated in the memoir also lead to the suspicion, that under conditions very different from those of M. Morin's experiments, the friction may not be entirely independent of the extent of the surfaces, but this subject will require an especial study.—*Comptes Rendus de l'Académie des Sciences de Paris, April 26, 1858.*

NOTE.—It is worthy of notice in this connexion, that the observations of the Committee of the Franklin Institute, upon the friction of vessels being launched, lead to a coefficient only about one-half as great as that determined by M. Morin. See *Journal Franklin Institute*, 3d series, vol. vii, page 108.

Ed.