the *capabilities* of Atmospheric Railways. Experiments have been tried—this characteristic of speed has been brought by them into perfect doubt, and the Atmospheric Railway, as regards economy, has found, even in locomotive engines, a powerful adversary.

It is a fact that, for working an Atmospheric Railway by the present means, an immense power is employed.

It is a fact that with high exhaustation only light trains are carried.

It is a fact that with these trains only irregular speed is obtained.

Are these owing to inherent defects in the system itself, or to the means employed to carry it out?

The only way of solving this question is to define the *capabilities* of the Atmospheric principle; and out of these capabilities, of their causes, of their origin, we shall derive the means of expressing them.

It is generally known, that for creating the rarefaction of the air isolated in the propelling tube, *for exhausting* this tube previous to the starting of the train, some free spaces must be opened to the air. To open these spaces requires a power on every square inch of their surface, which is very little in the beginning of the operation, and increases as the air becomes more rarefied, till it arrives at the point determined for the starting of the train.

The economical consequence of the nature of this first operation—*exhaustion*—is, that power will be lost in opening the spaces necessary if the working apparatus—is not capable of *proportioning, in every moment of the operation*, the power applied to the real resistance.

Exhaustion being produced, the piston is allowed to proceed and draw the train *traction* begins. The power acting on the head of the piston whilst this operation is effected, must be kept constant and regular; and, therefore, the air being wanted to occupy the same space, a space equal to the propelling tube must be opened. The pressure on every square inch capable of opening it, is that exercised on the piston; and we find that, supposing a piston which should transmit to the train the whole of the power received, the power capable of producing traction is exactly the power usefully employed.

The amount of power expended for one operation differs thus from the useful power, by all that is expended for producing *exhaustion*. But let us suppose that the air of the propelling tube has been collected after the operation: this rarefied air has a certain value as a power; this value, if it has been properly produced, is equal to the power employed to produce it, less the friction of the apparatus. It can, if the apparatus allows, be employed to produce a certain amount of power, to be used for a new operation; and we conclude from these facts that a Railway can be worked by Atmospheric pressure by the expenditure of the power usefully employed, and a small surplus for friction of machinery; but for this purpose the working apparatus must allow the variable application of power, a large space to collect the rarefied air, the facility of changing the decreasing value of this air into a new power, and the absence of these conditions in the apparatus actually employed, together with their enormous amount of friction, will explain their extraordinary waste of power.

Whatever be the object to be attained by mechanics, there are certain forms, certain principles, which must be introduced into the apparatus destined to obtain it. These forms we draw then from the *capabilities*—from the reasons of the *capabilities* of the agent employed. One of the *capabilities* of the Atmospheric Railway is *economy*—the greatest possible *economy*; but we have a very great example of a grand principle spoilt, shortened by improper means, in an Atmospheric Railway worked by air pumps.

We have supposed, besides, that the whole of the pressure applied on the piston was transmitted to the train; and here, again, we must take, in the nature of Atmospheric pressure, some arguments against the present construction.

It is not a reason, because speed is the natural characteristic of Atmospheric pressure in its action, to conclude that speed will be obtained by it, in any case, under any circumstances. A good principle does not avoid the necessity of good practical conditions; and should speed exist even without these conditions in Atmospheric Railway, it would be always attended by absence of economy.

One of the most precious *capabilities* of Atmospheric pressure as a power is, that this power does not take its bearing, its support of impulsion, in any piece of machinery; that it acts without friction; and the only amount of friction necessary in a piston receiving its effect, is that capable of maintaining it air-tight. If we suppose that the resistance to be overcome by the atmosphere be transmitted to this piston in such a manner that all its parts be in equilibrium, that no strain be brought more on one side than on the other, the resistance existing in direct line with the power, there is no mechanical intermedium between them; but in the ordinary disposition of a piston, the resistance existing above the tube, is brought in communication with the piston by means of a lever, of a mechanical piece, the effect of which is to throw more or less friction on certain parts of this piston. There is then on it an amount of resistance, increasing with the weight of the train, exactly as that of the bearings on a locomotive engine, and Atmospheric pressure is reduced to act as any mechanical contrivances.

The result of this is, that a considerable part of the power is wasted, that the mutual communication from the piston to the train is imperfect, partial, and, in Atmospheric Railways especially, speed cannot exist if there be not entire, direct application of power.

In a locomotive engine, the resultant of the power is brought in direct contact with that of the resistance. Speed is produced by the constant *action* of a power superior to the resistance; and when the whole mass of the train has been *impelled, its momentum reacts upon the locomotive.* If any cause tends to retard it, the locomotive itself attains a momentum which regulates its action.

The piston—the material representative of the power in Atmospheric Railway—is not capable of any momentum. By its actual construction, it is indirectly connected to the train; and let us suppose that any circumstance, as often occurs, should retard, stop its progress, how would the train, which only receives a part of the power, regulate its effect? What loss would exist in this *return of power partially transmitted; how would* the *vis inertiæ* of the train be entirely destroyed?

Why, then, not adopt on Atmospheric Railways the same disposition as with locomotives? Why not bring on the same line the resultant of the power and that of the resistance?

We shall obtain therefrom a saving of power? we shall insure a regular and cheap speed? and bring into practical effect this *capability* of Atmospheric pressure—*of acting without the intermediation of any mechanical agent.*

In all mechanical combinations the support of *the power is some metallic surface, some wheel*, some shaft; therefrom arises friction proportionate to the work performed. Atmosphere has its bearing in itself; it does not require any of our material supports. And this is the grand difference which distinguishes such a natural agent from human productions, ingenious but imperfect, narrow as our means.

N. A. Burnier.

Dufours-place, Aug. 17, 1846.

THE PROGRESS OF THE ATMOSPHERIC SYSTEM.

The question of a higher speed, combined with greater safety, appears to have been almost universally decided in favour of the system of Atmospheric traction. The matters now to be decided, in reference to a comparison of its asserted advantages over locomotive propulsion, are those of regularity and economy. The latter question —one of a very comprehensive character—we do not purpose to enter into in the present notice of the progress of the system; our object is merely to state a few facts with respect to the regularity with which the traffic of the Croydon Atmospheric Line is now carried on, and the speed which is regularly maintained, both by express and stopping trains, over a distance of barely five miles. For this purpose, we give below the details of the working of a considerable number of trains on Tuesday last. The table exhibits the number of carriages, the weights of the trains, the time allowed by the time-bills and the time occupied by each train in its journey, and the maximum velocity obtained. It is necessary to state, in the first place, that the "stopping trains" stopped at three intermediate stations to take in and set down passengers; secondly, that a strong side wind prevailed throughout the day, and that one engine only was at work at the Norwood station. It will be observed that the table of the working of the trains is one, the publication of which can be justified only by the fact of its being founded upon the most delicate and careful observations. Our readers will be sufficiently assured of its value, from a statement of the mode in which these observations were made. They were taken by three gentlemen having long experience in these matters; two of whom kept time, each with one of Frodsham's marine chronometers, and the third noted the velocity of the trains by one of the split-seconds stop-watches, of Arnold & Dent's manufacture. It will be recollected that Mr. Hudson, in his answer to the attacks made upon the Eastern Counties' Company by the correspondents of the Times, stated, with a justifiable degree of pride, that the average loss of time upon more than 4,000 trains run during a long period on that line, was not more than three quarters of a minute, or *forty-five* seconds per train. It is seen that the average loss on the Atmospheric is not an appreciable *quantity*, being not quite equal to *one eighth* of a second per train. In any case where an excess appears, it was solely owing to the delay occasioned by the numerous passengers at the frequent intermediate stations:

Hour of Train starting.		Number of Carriages.	Estimated Weight in Tons.	Maximum Speed in Miles per Hour.	Number of Minutes allowed by Time Bills.	Time taken to perform each journey from platform to platform.
	h.m.					m. s.
Up	8·	8	52	35¼	15	17·16
Down	8·15	8	44	30	18	15·2
Up	8·50	7	45½	51¼	10	10·4
Down	9·15	8	44	45	18	14·11
Up	9·50	7	46½	51¼	8	8·15
Down	10·15	8	44	40½	18	14·53
Up	10·50	4	26	60	8	7·50
Down	11·15	9	50	39	18	18·37
Up	12·15	8	44	35¼	15	15·18
Down	12·15	8	44	39	18	16·19½
Up	1·15	8	44	38½	15	16·20½
Down	1·15	7	38½	33½	16	18·33½
Up	2·16	7	38½	30½	15	15·32½
Down	2·45	4	22½	46	10	8·44½
Up	3·15	8	44	36	15	16·3½
Down	3·45	5	32½	43½	10	9·10½
Up	4·15	9	68½	32½	15	17·20½
Down	4·45	9	60	31	18	19·15
Up	6·15	8	38½	38½	15	18·16
				Total..	277	277·2½