

controversies which arose out of his laryngoscopic work), was rendering him unfitted for the energetic performance of his professorial duties, he withdrew to Leipzig, where he was made Honorary Professor at the University, and where he continued to reside until his death, on Sept. 16 in the present year.

Carried off while yet in the prime of his life, and the energies of his last few years impaired by an insidious disease, Czermak has perhaps left a mark on the scientific progress of his time incommensurate with his talents or his promise. He will doubtless be best remembered through his laryngoscopic labours. We owe to him the real introduction into medical practice of this valuable instrument. But his other researches, such as those on the action of the vagus, the pulse, the sense of touch, the manège movements resulting from injuries to the brain, those on dyspnoea, and others, show remarkable acuteness and clearness of insight.

Two talents he possessed deserve special notice. He had remarkable aptitude in devising apparatus for observing or for demonstrating physiological phenomena. It was this faculty which made him successful where others had failed in the use of the laryngeal mirror; and would be difficult to exaggerate the immense help to experimental physiology which has been afforded by the ingenious "holder" which bears his name.

The other faculty, that of popular exposition, less common in his country than in ours, he possessed to a very high degree. And his popular lectures, which were originally delivered at Jena, and which were reviewed in an early number of NATURE, achieved and deserved great popularity.

Perhaps had his love of teaching been less strong, his work as an investigator would have been more sustained and weighty. But while in this country we might with profit often lose a lecturer and gain an investigator, Germany could well afford that one whose powers of rigor and yet clear and popular demonstration were so exceptionally great, should somewhat slacken in his work as an inquirer. Or perhaps we should not so much say that Czermak slackened in inquiry, as that the consciousness of his power as an expositor, and the delight he consequently took in exposition, drew much of his energy in that direction. In the grounds of his residence at Leipzig he had built and fitted, at his own expense, a large hall, or "spectatorium," as he called it, in which he proposed to deliver lectures on physiology, richly illustrated with experiments. In connection with the hall, the construction of which was admirably adapted in every way for its purpose, he had also erected a private laboratory for research; and on both he had spent much time and labour. They were intended to be a supplement—not a rival—to the more technical institute of Prof. Ludwig in the same city. The writer will never forget the delight with which Czermak showed this "Erklärungs-Tempel,"—as he was fond of calling it—to Dr. Sharpey and himself in the summer of 1871, and pointed out all its ingenious contrivances, and the enthusiasm with which he looked forward to the lectures which would be delivered, and the work which would be carried on in it. He lived to open it by an inaugural lecture in December 1872; but the effects of his fatal disease were already painfully evident; and after a vain struggle during the following summer, Czermak—just as the British Association was gathering for its meeting at Bradford—was taken away from his unfinished work. He was a man of broad culture, outside his professional attainments. In philosophy especially he was well versed; and his last contribution to scientific literature—a paper in "Pflüger's Archiv," on the mesmerism of animals—was doubtless prompted by his interest in psychological questions. His straightforward, generous, and unostentatious manner formed a fitting frame for his intellectual attainments.

A widow and children mourn his death. He is also

mourned for by many friends in many lands, both by those who had known him long and by those who knew him for a short while only.

M. FOSTER

THE ATMOSPHERIC TELEGRAPH

THE *Times* of the 15th inst. contained an article on the Pneumatic Despatch, which has never been used to any extent in this country. From that article we learn the following particulars as to the working of this method of conveyance in London:—

The pneumatic tube extends from the London and North-Western Railway Station at Euston Square to the General Post Office in St. Martin's-le-Grand. The central station is in Holborn, where is also the machinery for effecting the transit of the trains. Here the tube is divided, so that in effect there are two tubes opening into the station, one from Euston to Holborn, and the other from the Post Office. The length of the tube between Holborn and Euston is 3,080 yards, or exactly a mile and three-quarters, a greater length than was originally contemplated, but which was rendered necessary by the avoidance of certain property on the route. The tube is of a flattened horse-shoe section 5 ft. wide and 4 ft. 6 in. high at the centre, having a sectional area of 17 square feet. The straight portions of the line are formed of a continuous cast-iron tube, the curved lengths being constructed in brickwork, with a facing of cement. The gradients are easy; the two chief are 1 in 45 and 1 in 60, some portions of the line being on the level; the sharpest curve is that near the Holborn station, which is 70 ft. radius. The tube between Holborn and the Post Office is 1,658 yards in length, or 102 yards less than a mile, and is of the same section, and similarly constructed to the first length. Two gradients of 1 in 15 occur on the Post Office section, but this steep inclination is in no way inimical to the working of the system. The Holborn station is situated at right angles to the line of the tubes, which are therefore turned towards the station into which each opens. All through trains, therefore, have to reverse there, and this is effected in a very simple manner by a self-acting arrangement. A train upon its arrival runs by virtue of its acquired momentum up a short incline, at the summit of which it momentarily stops; and then quickly descends by gravity. In its descent it is turned on to a pair of rails leading to the other tube, into which it enters and through which it continues its journey, the whole process of reversing occupying barely 30 seconds. Trains containing goods for the Holborn station are simply run down from the top of the incline on to a siding.

The waggons, or carriers, as they are termed, weigh 22 cwt., are 10 ft. 4 in. in length, and have a transverse contour conforming to that of the tube. They are, however, of a slightly smaller area than the tube itself, the difference—about an inch all round—being occupied by a flange of indiarubber, which causes the carrier to fit the tube exactly, and so to form a piston upon which the air acts. The machinery for propelling the carriers consists of a steam engine having a pair of 24-in. cylinders with 20 in. stroke. This engine drives a fan 22 ft. 6 in. in diameter, and the two are geared together in such a manner that one revolution of the former gives two of the latter, or, in technical terms, the engine is geared at 2 to 1 with the fan. The trains are drawn from Euston and the Post Office by exhaustion, and are propelled to those points by pressure. The working of the fan, however, is not reversed to suit these constantly varying conditions; it works continuously, the alternate action of pressure and exhaustion being governed by valves. The engine takes steam from three Cornish boilers, each 30 ft. long and 6 ft. 6 in. in diameter. Telegraphic signalling is carried on between the three stations by means of needle instruments.

The system of Pneumatic Despatch, or "Atmospheric Telegraph," as the French call it, is utilised to a much greater extent in Paris than in London, though with some important differences in construction and object. We have thought that some details concerning the working of this system in Paris might be useful and interesting at the present time, and we therefore give an abstract of some articles on the subject which have recently appeared in *La Nature*.

The question of the distribution of messages in the interior of towns has revived the systems of pneumatic transport, which, after having had their day of celebrity, seemed for twenty years doomed to oblivion.

In following the aspects of this question, we shall show in what way the atmospheric telegraph is a result of the electric telegraph; we shall afterwards consider the former more specially, and after having shown its present condition, shall inquire what future is in store for it.

The telegraphic despatch has become an article of everyday use; as the age is a fast one, it is natural that it should utilise with eagerness so handy a means of transmitting almost instantaneously its impressions or its wishes to all distances. It is necessary to remember that a city like London or Paris sends out and receives every day an immense number of telegrams. The wires which serve as conductors of electricity are multiplied in all directions for the purpose of meeting the demands of this traffic. They meet in the interior at the central office. This central station speaks *urbi et orbi*; in other words, it receives the messages of the city for the purpose of spreading them over the entire world, and it accomplishes also an inverse movement. The aspect with which we are here concerned is the distribution throughout the city itself; let us see what has been done in Paris to accomplish this purpose.

As each house cannot be put in immediate communication with the telegraphic network, it became necessary to adopt some other convenient plan. In the case of Paris, the city is divided into districts of a mean radius of 500 metres in order to limit the journeys of the foot-messengers. The application of this rule gave fifty points, distant one kilometre from each other, where are established so many branches of the chief office.

This system was found, however, not to work well, and was moreover very expensive, for reasons which we need not detail here; and after *voitures* were tried for some time as a means of sending despatches from the head office to the more important branches, it was resolved to have recourse to the pneumatic tube. We have just referred to the extent to which it has been carried in London. Paris and Berlin followed the example of London in 1865; we shall speak here of the system of Paris.

In Paris there are fifty stations, distant from each other about a kilometre, connected by an iron tube, which is interrupted at each station. The central station, by which the transit of messages is effected with the interior, is in the Rue de Grenelle; there are seventeen district stations, in the Rue Boissy-d'Anglas, Grand-Hôtel, Bourse, &c.

How is this network managed? Like a diminutive subterranean railway, in which the waggons are cylindrical boxes and the motive power compressed air prepared in the stations. At the central bureau the trains are formed, composed of as many boxes as there are branch offices to supply. The trains are *omnibus* when they stop at the intermediate stations, *express* when they shoot past them.

Every quarter of an hour an omnibus train leaves the Rue de Grenelle, and accomplishes the distance which separates it from the Rue Boissy-d'Anglas (1,500 metres) in a minute and a half. There it is received in a vertical column, and the box which carries the messages to be distributed in the district having been taken out, the others are put into the section of the line which

runs towards the Grand Hotel, a new box having been added containing messages to be transmitted, which have been deposited since the last train. The train again takes its departure, composed of as many boxes as before; it goes through the same operations at the Grand Hotel, the Bourse, the Théâtre Français, and at the Rue des Saints-Pères. It re-enters the Rue de Grenelle twelve minutes after its departure, having changed all its boxes and carried back messages for distribution.

Besides this there is a secondary network, the details of which, however, we need not now enter upon. There is a direct line which goes from the Rue de Grenelle to the Bourse, and to branches in the Champs-Élysées, the Place du Havre, and the Rue des Halles. On the first run the express trains going and returning, the departures of which are intercalated between those of the omnibus trains, for the purpose of supplying those stations which are busiest, twice every quarter of an hour. The departure is accomplished by pressure, the return by aspiration. The same method of working is applied to the branches, which correspond with the omnibus trains of the principal network.

The tubes which compose the lines are of iron, the interior diameter being 0.065 metre. They are connected by bridle joints (*à brides*), and admit of curves having a radius of from 5 to 20 metres.

Various systems for the production of compressed or rarified air are employed. The first in date is an application of the principles of the apparatus known as Hiero's Fountain. Atmospheric air is decanted from a first receiver B (Fig. 1) into a second receiver communicating with the first by means of the tube *bb*, by the introduction of water into the receiver B. The air thus forced is drawn into the receiver for the purpose of being dispersed in the tubes. Where the machines are not allowed to be used, the employment of steam is much more economical for the compression of air. Recourse is then had to ordinary pumps, which insure an active service and are subject to fewer causes of irregularity. The latter method has been preferred in recent establishments.

Trains composed of ten boxes weigh about four kilograms, they are either pushed or sucked along by a difference of pressure of three-fourths of an atmosphere, which gives a mean speed of a kilometre per minute.

The travellers which take their places on the Lilliputian carriages already described are closed envelopes containing messages; they are piled in groups of thirty or forty in a *courseur*, or box. This box is formed of two cylinders, the interior one of sheet-iron, the outer one, enveloping the former, of leather. To make up a train, a piston must be affixed after the last box, for the purpose of enabling the compressed air to take effect. The piston is a piece of wood provided with a leather collarette, which assumes the shape of the interior of the tube, and forms an almost hermetical joint, without much friction.

The apparatus at first adopted for receiving and despatching the boxes having been found neither sufficiently rapid nor convenient, a much more complete system, shown in Fig. 2, is now employed. The figure explains itself: two lines enter the office, each attached to separate apparatus. In the first place, for the purpose of despatching messages, a man opens the door A by means of the lever *d*; the boxes and the piston are thrown into the tube, and await at the bottom the current of air which will propel them. This current is produced as soon as the cock *ε* is opened, which commands the head of the apparatus opposite to the tube. The cock *c'* distributes the air upon the second line. In the second place, the receiving door B is opened by a second attendant, who finds the train at the station, and takes out the boxes in order to bring the telegrams to light. The entire apparatus has somewhat the form of a cannon, only the effect is more blessed, the artillerymen are not exposed to death;

the worst accident they have to fear is the bursting of the tube. To this drawback, which happens very rarely, we shall refer by-and-by.

The messages are divided into two classes,—questions

and answers, orders and the execution of orders, which can at once be exchanged between any point of the city and any point of the interior, in the provinces, or abroad,—or inversely. All that is necessary in this case is a

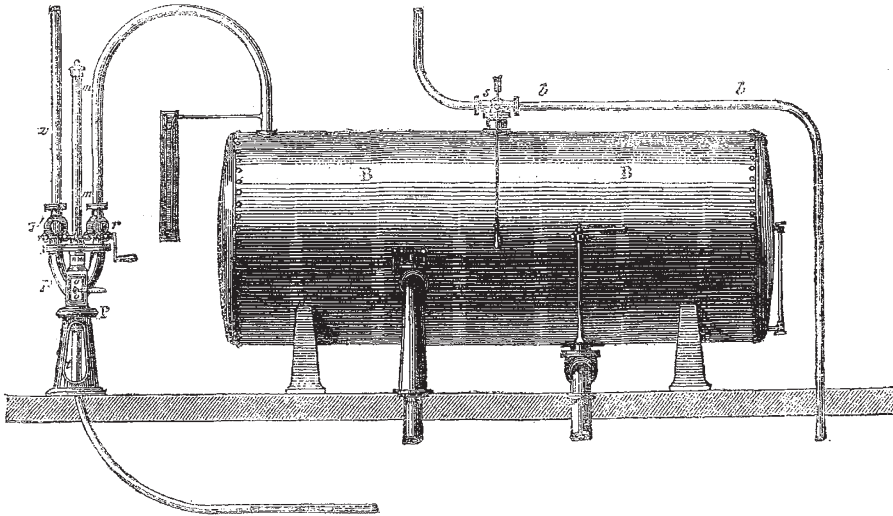


FIG. 1.—Apparatus for the production of compressed air.

centre, as the Hôtel des Télégraphes in the Rue de Grenelle is called. Connected in the one part with the exterior by the network of electric wires, and

with the interior by the network of pneumatic tubes. These tubes are, moreover, well adapted for the service of the local post, *i.e.* for the exchange of messages within

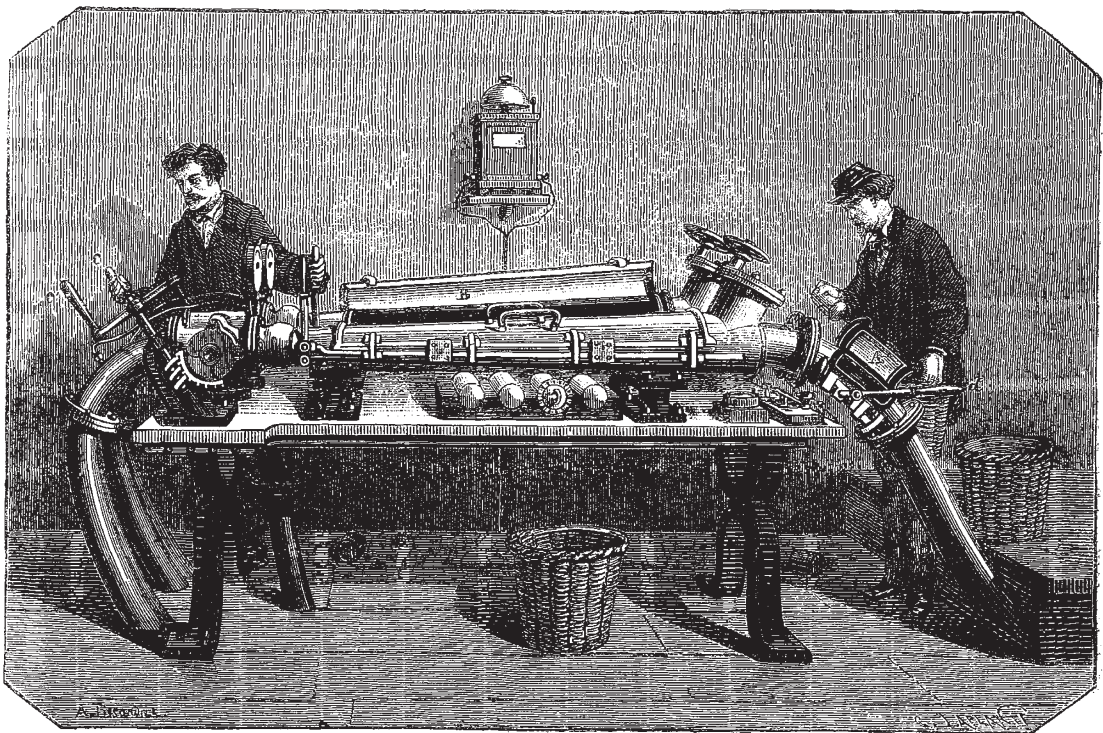


FIG. 2.—Apparatus for reception and despatch.

the city. The great advantage in this case is that the despatch can be sent. On the plan adopted, when the network is complete, a letter may always be sent from one quarter to another at any distance within Paris in less

than an hour. Every year the development of the lines increases, and the number of Paris telegrams meant for the city, and of which the originals themselves can be transmitted, is getting greater and greater.