volume of water that has taken its place in the cylinder. The part of the chain to the right of the counterpoise will have become two meters longer than that near the car. In order that an equilibrium may be maintained, the two meters of chain must equal the weight, p, and the meter of chain must therefore weigh $\frac{p}{2}$.

The conditions of a permanent equilibrium in all positions are, therefore, the following: (1) Counterpoise equal to the weight of the car and semi-immersed piston; (2) balancing chain, weighing to the meter half of the weight of the volume of water corresponding to a displacement of one meter of the piston.

This system of overhead balancing presents certain inconveniences, and there are sometimes difficulties in the way of installing transmissions above. Various other arrangements have been devised, and, to cite only what has been done in France, we may mention the Heurtebise system (Fig. 4, Nos. 2, 3, and 4). This system is based upon the use of a compensator formed of two cylinders, A and C, one of which receives the pressure of the water, while the other communicates with the well of the elevator. In these cylinders moves one piston in common, D, whose weight compensates that of the car and the column—the whole constituting a sort of hydrostatic balance.

It will be remarked that if the travel of the piston and compensator are in the ratio of 1 to 10, the latter will have to have a weight and section ten times that of the former. So the trouble with this system is the difficulty of establishing and maneuvering so large masses. Besides, the compensator balances nothing but the invariable part of the dead weight. The arrangements adopted for counterbalancing the variable part of the load have farther complicated the apparatus.

The successive arrangements to which recourse has been had are shown in Fig. 4 (Nos. 2, 3, and 4). The first consists in the use of chains, F, and counterpoises, G, which are huge by reason of the ratio of the travels. This arrangement operates under the same conditions as the balancing by counterpoised chains shown in Fig. 4 (No. 1). An endeavor has been made to attain the end by the action on the compensator of counterpoises, P, fixed to the extremities of large levers, T, whose variable inclination, connected with the motions of the compensator, vary the action exerted upon it (Fig. 4, No. 3).

Finally, an application has been made of oscillating cylinders (Fig. 4, No. 4). The cylinders, K, being in a horizontal position when the elevator is in the center of its travel, the action of the piston is null, but if they are revolving on their axes in one direction or the other, the compensator will receive a vertical thrust from them whose energy will increase in a certain proportion in measure as they depart from a horizontal position. However, it must be remarked that, to the detriment of the useful effect, while the modification of the weight of the piston is always equal per unit of distance traveled, the same is not the case with the vertical component of oscillating pistons. These latter must, besides, be provided with special accumulators, M, which, although they prevent variations in the pressure of water conduits, and diminish the surface of the pistons, are nevertheless a still further complication of the apparatus.

Mr. Abel Pifre has recently replaced the apparatus for balancing dead weights by a float that receives a thrust which counterbalances the useless weights. This float is placed at the lower extremity of the piston supporting the car. This is one of the simplest of solutions, but no regard is paid to the variations in the weight of the piston.

From what precedes, it will be seen that the system of balancing by weights and chains is the completest and least complicated. Originally, when the pistons were of cast iron, it was even the only one applicable, and it is only as a consequence of the progress of metallurgy that the system of balancing beneath has become possible.

Mr. Edoux has adopted a new arrangement of this kind without in any way modifying the principle of his first one. The chains and counterpoise play exactly the same role as before, the transmitting parts alone being shifted. In this new arrangement (Fig. 3, and Fig. 4, No. 5), the cylinder terminates at the top in a tight metallic box of small size, in which are inclosed all the transmitting and guide pulleys. A chain passing beneath the piston winds around these pulleys and supports an annular counterpoise through which the piston passes, and which runs up and down the entire length of the cylinder. In determining the weight of the counterpoise and chain, regard is evidently paid to the influence of the liquid in which they move—a circumstance that is an advantage, for, in fact, it involves an increase in weight per meter of the chain, and, as the weight that the latter has to support remains the same, there results a further guarantee of safety. Moreover, in this system, a breakage cannot affect the safety of the passengers, nor even occasion any material damage.

Mr. Edoux has also introduced an improvement into the distributer, which he maneuvers through a small hydro-electric apparatus (Fig. 1). This auxiliary motor is a multiplier of force.

The maneuvering lever of the distributer is connected with the rod of a small hydraulic double-acting piston, C, which is provided at the center with a distributing cock. Four pipes end in this, one leading water under pressure, two carrying the water to the extremities of the cylinder, and one allowing it to escape. The cock is maneuvered through levers which carry, each of them separately, two counterpoises, B. At rest, these levers are raised, and the counterpoises bear against two spring tappets which are set free by passing an electric current into the electros, A. The levers are loose under the rod of the cock, and are maneuvered through the intermedium of a disk keyed upon the axis. When one of the catches is freed, the corresponding weight falls, its rod revolves and carries along the disk keyed to the axis; the cock opens, and the water acts against one of the faces of the small piston whose rod maneuvers the distributer.

The counterpoises are raised and put back in place automatically, by means of a vertical bar connected with the piston rod, whose motion it follows.

In the car, and at each landing, there are two contact buttons, by means of which one or the other of the electros is made to act. In this way, the ascending or descending motion of the car is arrested. Fig. 3 shows, in one group in common, the latest improvements introduced into the elevators just described.—*La Nature.*

PROF. ASA GRAY.

A Monkey's Trick.

A few days since, for the third or fourth time within a year, a monkey figured as an incendiary, firing the well known steam yacht Norma, lying at a wharf in New York. It seems to have gone about the job with the greatest deliberation, too—gnawed through the ropes with which it was tied up, cleared out a match safe in the cabin, and then started the blaze in a place which only a monkey would have thought of, between the deck and the ceiling of the coal bunkers. It took the crew all night to locate and put out the fire, which was filling the boat with smoke, the monkey, whose part in the affair was established by indisputable circumstantial evidence, being afterward found on an eccentric bar in the engine room, quietly grinning over the rumpus which it had raised. *Fire and Water* suggests that monkey risks will be next heard of in insurance circles if this kind of thing keeps up.

PROF. ASA GRAY.

The great botanist who did so much for American science, and who contributed as much or more than any other scientist of this country to its reputation abroad, died at his home in Cambridge, Mass., on the evening of January 30, 1888. For several days he was in a semi-conscious state, from which he never rallied. For over a month he had been helpless from paralysis.

He was born in Paris, Oneida County, N. Y., on November 18, 1810. He studied medicine, graduating from Fairfield Medical College in 1831. He did not practice his profession, but devoted himself to botany. A few years later he received the appointment to the position of botanist to the Wilkes Exploring Expedition. This was about 1835. But as delay after delay occurred he became weary of waiting, and resigned the position. In the period of waiting he began work upon Torrey and Gray's "Flora of North America," whose first volume appeared in 1840.

The chair of botany in the University of Michigan was offered to him, which he accepted on condition that he be allowed a year of study in Europe. He was one of the first professors appointed to a chair in the young college which has since acquired a high standing among the country's educational institutes. He visited Europe, carrying with him the commission to purchase a library for the college. He selected a nucleus for the collection of books with great judgment. It is said that the collection thus selected is still looked upon with great pride by the university. He never entered upon the duties of the position of professor there; but at its semi-centennial celebration last summer the university conferred upon him the degree of LL.D.

His year in Europe he devoted to the study of the herbaria. In these he found many examples collected in the early expeditions to America. Thus his life work was commenced in the study of these old type specimens of North American flora. On his return, he resumed work upon the flora, the second volume of which appeared in 1845. Three years earlier, he began his long service in Harvard College, accepting, in 1842, the newly established Fisher Professorship of Natural History. He died while still an occupant of this chair, though relieved from the duty of teaching and care of the botanic garden in 1872.

The herbarium under his charge acquired great dimensions, and became of immense value. He kept up his literary pursuits. His great work was the study of the North American flora, begun about fifty years ago. About 1871, this took the form of a work entitled "Synoptical Flora of the United States." It is not yet finished. Besides this, he wrote many monographs and special studies. In 1854, his work on the "Botany of the Wilkes Expedition" appeared. In 1859, he published his work on the "Relations of the Japanese Flora to those of North America." This work, he thought, did more to make him known in the old world than any other single production. His educational manuals attained an immense success, and it is not saying too much to affirm that the botanists of this continent have been brought up upon the pabulum supplied in them.

His work on the Japanese flora tended toward evolution, and he was one of Darwin's most esteemed friends and powerful advocates in this country. At the same time he never could find in natural selection a satisfactory cause for the law and order he beheld so clearly in the world. Like Clerk Maxwell, he found it an insufficient explanation, and back of it recognized the existence of a first cause. His religious and scientific beliefs are best summarized in his own words:

"I am scientifically, and in my own fashion, a Darwinian, philosophically a convinced theist, and religiously an accepter of the 'creed commonly known as the Nicene,' as the exponent of the Christian faith." His reasons for this position were fully given in a short course of lectures before the Theological School of Yale (1880).

He wrote many reviews and other papers for the journals of the day. He was one of the regular contributors to the *Nation*, of this city. He was an associate editor of the *American Journal of Science and Arts.* In the latter paper he published annually the necrology of the botanists who had died during the year. On his writing table he left the unfinished necrology for 1887.

ACCORDING to native journals, Japan can boast of a phenomenal giantess. Though only twelve years and five months of age, she is said to stand eight feet high and to weigh over two hundred and seventy pounds; her hands measure over nine inches in length, and her feet fifteen inches.

Running Locomotives with Natural Gas.

For some time, it seems, experiments have been quietly conducted by Gen. Supt. W. W. Worthington and the General Master Mechanic of the Fort Wayne, Cincinnati & Louisville road, with a view to the transportation of natural gas in tanks, for use in heating and lighting cars and for fuel in the fire box of the locomotive.

The experiments have been successful enough to warrant the hope that the time is soon to come when the public will be able to ride on smokeless and cinderless cars, and where the entire heat, light, and power come from natural gas. The idea at the base of the experiments was that the pressure that comes from the depths of the earth might force the gas in a condensed form into wrought iron or steel receptacles, which could be sealed up and carried any distance, then attached to pipes and used in the ordinary manner. A special to the *Chicago Tribune* says of it:

The first trial was made at Montpelier, Ind., where there are two strong gas wells. A wrought iron cylinder, 18 feet long and 2 feet in diameter, with heavy ends screwed in, was attached to the biggest well. The cylinder had been subjected to careful and scientific tests at the shops, and was provided with gauges to register the pressure. This well has a rock pressure of 450 pounds to the square inch, and when it was turned on, the gauge on the cylinder fairly danced round, and in a minute almost came to a standstill, showing the cylinder was full and would register no more. The cylinder was then hoisted into a freight car and brought to Fort Wayne. Here it was taken into the company's shops and attached to the usual natural gas burning apparatus, with a "regulator" that controlled the enormous pressure under which the gas had been forced into the cylinder, so that it flowed out in a steady, regular current. This "regulator" was manufactured at Pittsburg, Pa., and is in use, it is said, wherever natural gas is used; and when the gas flows through it, it reduces the pressure from 450 pounds to the square inch, or whatever it may be, to 1½ ounces, at which pressure natural gas is burned. The gauge showed that the gas in the cylinder had lost but little of its pressure, and it supplied light to the gas burners in the shops for several hours, besides heating one large stove and one forge.

The company, being satisfied with the tests made that gas could be transported and used in this manner, are making preparations to test its practicability for use on the road. For this a trial tank car of the shape and size of those used by the Standard Oil and various tank line companies of the country is being built. It will be of steel sections screwed together and banded with wrought iron welded on at the joints, so as to stand the great pressure. This car will be hauled just back of the tender, which will only be used to carry water, and a pipe from it will lead through the regulator placed on the tender to the fire box of the locomotive. Its capacity will be equal to as many thousand cubic feet of gas as will represent enough tons of coal to make the entire trip over the road. At different stations along the line, arrangements will be made for tapping the wells and filling the tank car at any time it runs low.

It is almost impossible to estimate the enormous saving that will follow this use of natural gas for fuel. It is said that the Lake Erie & Western Railway, which runs through the great gas fields of Ohio and Indiana from Findlay, O., to Tipton, Ind., has a machinist there watching the experiments, which may be of colossal value to that road. The General Master Mechanic and Master of Transportation of the Pennsylvania lines west of Pittsburg are also said to be there in the interest of their roads, and the experiments are being watched by the railway world with great interest.—*Amer. Engineer.*

[The pressure above indicated, 450 lb. per square inch, is equal to 30 atmospheres, or the compression of 30 cubic feet of gas into the space of one cubic foot. The experimental cylinder above mentioned, at 450 lb. pressure, was capable of carrying close on to 1,700 cubic feet of gas.—ED. S. A.]

A THEORY of obesity, proposed by M. Leven recently, and described before the Societe de Biologie, is that it is a nervous disorder, and to be treated by avoidance of mental and physical fatigue, and a diet of eggs, soup, milk, rice, and potatoes.

A REMARKABLE RAILWAY WRECK.

The wreck of two passenger trains on the Rochester (single track) division of the New York, Lake Erie, and Western Railway, one mile east of Avoca, on Tuesday, the 17th of January, was an interesting one, aside from the sad event connected therewith. The train from Rochester, No. 18, was drawn by engine 260, Frank H. Maynard engineer, and the train from Elmira, No. 107, by engine 69, Frank Marsh engineer. The blame has been placed upon the train dispatcher, but it would seem to be as just to attribute the accident to the system of train management. On the Pennsylvania Company's railways what is known as the "double order system" is in vogue. The traindispatcher will call two stations nearest the approaching trains, and issue an order to the engineers and conductors of the two trains to be affected. For instance: "Conductor D and engineer E, train 39, will meet and pass conductor F and engineer G, train 40, at York." The operators will each repeat the order back to the dispatcher and wait for his "O. K." before allowing the trains to proceed. On the New York, Lake Erie, and Western a separate order is issued for each train, repeated, and "O. K.'d," as common to all systems.

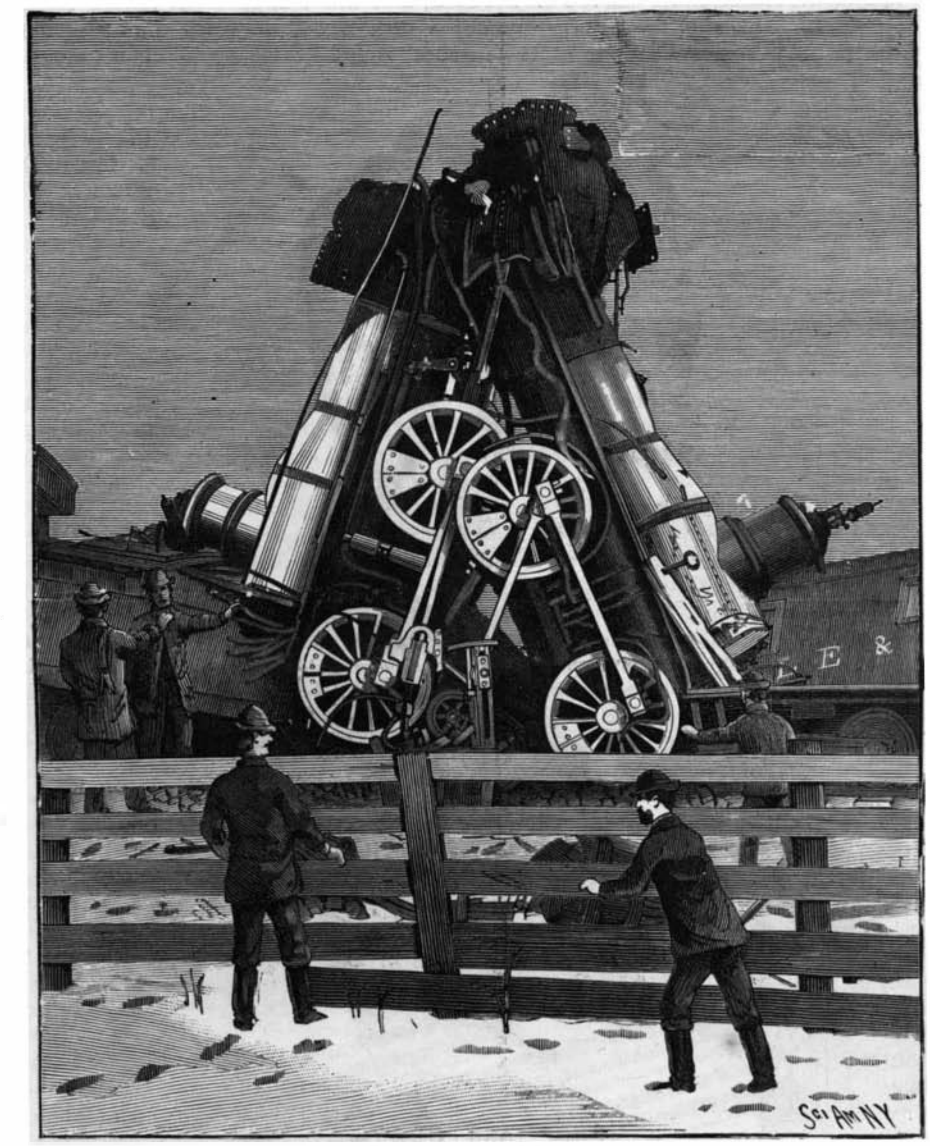
The confusion leading to the wreck near Avoca seems to have arisen from train 18 running behind train 107 instead of ahead, as usual when on time, and the train orders for the two getting confounded in the mind of the dispatcher. The dispatcher discovered his error, it is claimed, almost immediately, but on calling Avoca could get no response, as the operator had left his instrument to attend to the duties of baggageman or express agent, it being the custom at small stations to place the several titles and duties upon one man. Train 18 was fifteen minutes late, and Engineer Maynard remarked to his fireman, Frank Marsh, Jr., that he would have to "let her out." Both trains make high speed between stations. They met on a sharp curve. Engineer Marsh saw the down-coming train in time to pull the air brake lever and jump, his fireman having preceded him. Engineer Maynard was on the outside of the curve, and presumably did not have as good a view of the track ahead, a bit of woods with thick underbrush bordering the railway on the inside of the curve hiding the track ahead.

The curve is a short one, and on either side lies a mile or more of straight track, so that ten seconds difference in the time of one of the trains would undoubtedly have prevented the accident. Maynard's fireman happened to look ahead from his side of the cab at the right instant, shouted, "There they are, Frank," and leaped just as the trains came together. Maynard pulled the air brake lever just in time to set the brakes. It is apparent, also, that he put his head out of the cab window, as if to escape being crushed, but the cab was so broken that the hard wood frame acted like a huge pair of shears, cutting his head completely from his shoulders, so that it fell by the side of the track upon the snow. It is apparent that the air brakes saved all others on the trains from instant death. Nearly every one received a bruise of some kind, but none of them serious. It is seldom that two engines more completely wrecked are seen. Equal to each other in every particular, they met and stood erect as if to wrestle, their driving wheels wedged together, and machinery almost completely stripped from the boilers. The accompanying cut is from a photograph taken within an hour after the collision, by I. F. Moore, of Avoca. It was probably the most picturesque wreck, so far as the locomotives are concerned, that has occurred in years.

The unlucky incident is worthy the study of railroad managers. The writer is informed that two men, working twelve hours each, do the train dispatching on the division where the accident occurred, and he knows personally of dispatchers who work eight hours without cessation at their instruments in handling the many trains of a trunk line in New York State, besides doing a large amount of other telegraphic work, and then completing a day's work of eleven or twelve hours, often more, in making out the daily reports. This is done seven days in the week, and vacations come very rarely. Train management requires such a clear head that it cannot be done efficiently with the dispatcher constantly overworked.

A law limiting the hours of office work for a train dispatcher to eight would certainly insure greater safety to the public, and, it would seem, enable the dispatcher to handle his multitude of trains with greater facility. Further legislation to secure the constant attention of an operator at his instrument, undiverted by the duties of ticket agent, baggage or express agent, also seems advisable. Accidents so destroy public confidence in the safety of a railway that not only destroyed life and property, but diminished patronage, must be counted in footing up the loss.

The coroner's jury which investigated the cause of the death of Engineer Maynard found that an error in the train dispatcher's office at Rochester. The jury also found: "The company required Train Dispatcher Sauerbier to keep an account of and report daily all cars ordered, received, and on hand at date on the divisions of which he had supervision. The said divisions comprised about 170 miles of track, over which 36 trains passed daily. His duties as dispatcher required him to serve continuously twelve hours out of the twenty-four. We recommend that the railroad company employ a person other than the dispatcher to keep and make such car reports. We further find that said dispatcher had more duties to perform at the time of making such error than should have been required."



A REMARKABLE RAILWAY WRECK—NEW YORK, LAKE ERIE, AND WESTERN R.R.

Bricklayers in Frosty Weather.

A writer in the *Building News* (London), referring to a report issued from the Foreign Office, which he claims contained nothing but what every practical bricklayer in England already knows, offers the following substitute, which he thinks every bricklayer does not know:

Mortar made in the following manner will stand if used in almost all sorts of weather: One bushel of unslaked lime, three bushels of sharp sand; mix 1 lb. of alum with one pint of linseed oil, and thoroughly mix this with the mortar when making it, and use hot. The alum will counteract the action of the frost on the mortar.

Tests for Swords and Cutlasses.

In order to more completely insure the good quality of the swords and cutlasses issued to the British navy, orders have been given for the following tests to be applied to a large number of cutlasses which are to be repointed and reduced to a uniform blade length of 27 inches. First the sword is to be subjected to a direct vertical pressure on the hilt in a machine specially constructed for the purpose, and it is required to stand a pressure of 40 lb. without deviating from the straight line.

Then additional vertical pressure is to be applied in the machine until the sword is bent so that the distance from point to hilt is reduced 3 inches. Finally the blade has to be bent round a suitable curved block, so that every portion of it partakes of the bend, the distance from point to hilt being reduced 2½ inches. The sword also has to be struck with moderate force, back and edge, on a block of oak to test the soundness of the hilt.