capacity of 11,000 horse-power in one self-contained unit, and they will therefore be comparable in power with the largest prime movers of the reciprocating type.

An idea of the compactness of the new turbo-generating unit, and of the simplicity and pleasing contour of the design, is obtained from the accompanying illustration, which represents one of several which are under construction for the great central power station of the new Pennsylvania Railroad tunnel from Jersey City to Long Island. These machines will furnish power for operating with electric locomotives the heavy Pullman trains which will enter the terminal station from the west, and also for running the elaborate system of suburban trains that will operate from the same station. Three complete 500-kilowatt units are also being built for the equipment of the power station of the Philadelphia Rapid Transit Subway system, which is now under construction. Eight units, with a combined turbine horse-power of 88,000, will furnish power for operating the London Underground system, while three 5,000-horse-power turbines are being built for the street railway system of the same city. All of these turbines will use steam at a working pressure of 174 pounds per square inch, with from 100 to 175 degrees of superheat, and they will be operated with the high vacuum which is a characteristic of the Parsons-Westinghouse turbine.

The advantages of economy of floor space characteristic of the steam turbine are strikingly illustrated in this large unit, for in spite of its maximum capacity of 11,000 horse-power, the space occupied by the turbine measures only 13 feet 3 inches by 27 feet 8 inches, which works out at 30 horse-power per square foot of floor area, based on the maximum overload capacity of 11,000 horse-power. It is not too much to say that the economy in space of the turbo-generator ranks second only to its economies of operation, as it requires only one-fourth of the space necessary for the most modern, vertical type of direct-connected, reciprocating units of equal electrical output. In units of say 1,000 electrical horse-power, the ratio of space occupied is as 1 to 10. The machine operates at the low speed for a turbine of 750 revolutions per minute.

The machine rests upon a single bedplate cast in two sections, which are held together by links shrunk on. Upon this bed-plate are bolted the pedestals, the generator casing, and the turbine body; but it may be mentioned, as a curious outcome of the fact that there are no reciprocating parts to disturb the equilibrium of the machine, that the bed-plate itself is not fastened to the foundations by foundation bolts, but depends for immobility upon its own weight. The barrel or cylinder is cast like the bed-plate in two sections, secured by shrunk-on links, and it is heavily lagged with non-conducting material.

The rotating parts consist of a central steel shaft, with a diameter at the journals, which are of the solid, self-aligning type, of 15 inches—a remarkable drop in dimensions from the 34-inch shafts of a cross-compound reciprocating engine of the same capacity. Upon this shaft is carried the mass of radial blades that form the rotating portion of this type of turbine.

Steam is led to the turbine successively through an automatic quick-closing throttle, a hand-throttle, a strainer, and the main admission valve. Provision is made for admitting high-pressure steam to the second stage of the turbine, when it is desired to increase its capacity by fifty per cent on overloads. The main admission valve is a double-beat poppet valve, controlled by a small pilot valve, that is actuated by the governor. The steam is admitted to the turbine in puffs, the duration of which is proportionate to the load. At the outer end of the turbine shaft is mounted a worm which drives a short, horizontal cross shaft that operates at one end an oil pump, and at the other end the governor. This pump supplies oil to all the journals.

At the time, two years ago, when the SCIENTIFIC AMERICAN illustrated the large 12,000-horse-power cross-compound reciprocating engines of the Manhattan Elevated central power station, in this city, we stated that probably these were the last engines of their size and kind that would be built for electric generation. If the great turbo-generators herewith illustrated show, as they undoubtedly will, the same and even higher economies than have been realized in the smaller units, they will undoubtedly become the future drive for electric power stations the world over.

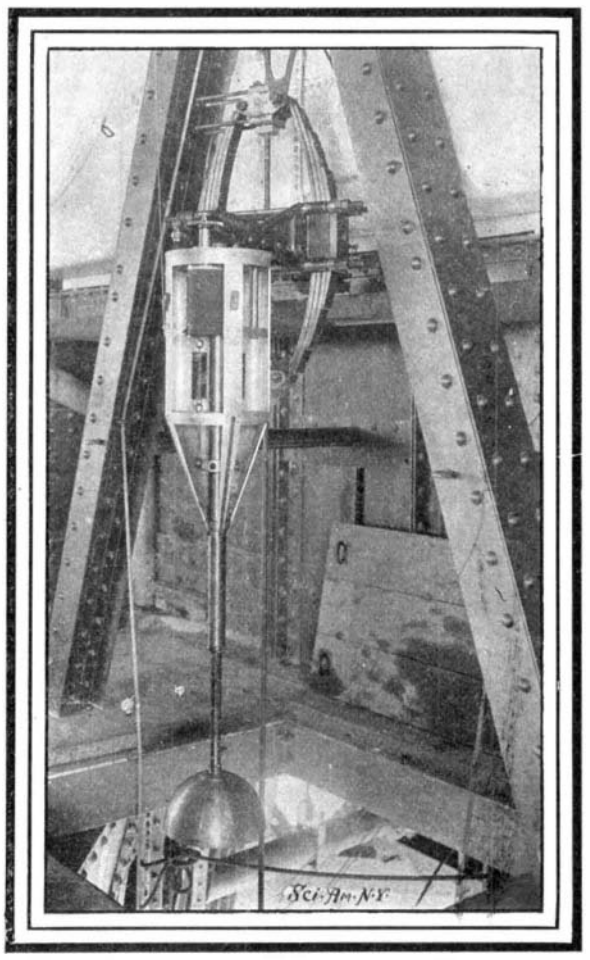
The Current Supplement.

A more interesting issue of the SUPPLEMENT than the current number, 1472, has rarely been published. Mr. John N. Cobb, one of the agents of the United States Fish Commission, discusses at length the sponge fishery of Florida and illustrates his text with many interesting photographs. Articles which will surely be read by the antiquarian are those on purses and on watch-dials. Dr. H. Schweitzer's paper on some new photographic chemicals is published. An excellent review of Blondlot's N-ray experiments is given. A consideration of calcium steel, the new rival of ceramic products, gives many a curious bit of information. Prof. D. I. Mendelejeff, whose name will be forever linked with the periodic law that he discovered, recently read a paper which he called "An Attempt at a Chemical Conception of Universal Ether." An abstract of this paper is published in the current SUPPLEMENT. Thomas W. Pritchard reviews the methods of distilling pine products now in use in our Southern States. "How to Build an Electric Oven" is the title of a practical article which will be found of value to amateur experimenters. The usual Engineering, Electrical, and Consular Notes will be found in their accustomed places.

EXPERIMENTS UPON THE PRESSURE OF WIND AT THE EIFFEL TOWER.

BY EMILE GUARINI.

Some very interesting experiments upon the resistance of the air have been recently made by M. G. Eiffel, at the tower which bears his name, by means of an apparatus of his invention which may be daily seen in operation when the air is calm. At a given signal, a cylinder carried by a double spring falls with great velocity from the second floor of the tower (that is to say, from a height of about 375 feet), along a vertical cable, and then progressively slows up, and stops without any shock at 3.28 feet from the ground, remaining attached to the cable. This cylinder, a part of which is conical, carries in front a plate which is thrust backward by the pressure of the wind during the fall. Such displacement compresses an accurately tared spring which measures the pressure and inscribes it upon a registering drum, the revolution of which is regulated by the fall itself. The ordinary inscribing style is replaced by a tuning-fork that makes 100 vibrations a second. When the apparatus is opened, there is therefore found inscribed upon the drum an undulating curve that gives for every point the height of the fall, the pressure acting at this moment, and the velocity, within an approximation of a hundredth of a second. This is the first time that one and the same apparatus has continuously indicated these various results from the zero velocity to that of 130 feet a second, which is that of the most violent winds.



APPARATUS FOR MEASURING THE PRESSURE OF WIND.

As the pressure device may be of any form and size whatever (a normal or oblique plane, a cone, sphere or cylinder), the apparatus is capable of giving more accurate and certain results than have hitherto been obtained in experiments on the resistance that the air offers to a moving body, and which is nothing else than the pressure of the wind upon a stationary body.

Such determination presents great practical interest, either as regards the utilization of the pressure of the wind as a motor, or the resisting of it, as becomes necessary in the practice of the profession of the engineer and in experiments with dirigible balloons.

In order to complete the description of the apparatus, the principle of which has just been indicated, it suffices to add that in order to diminish the effect of the velocity of this mass of 265 pounds moving at the rate of 130 feet a second, say nearly 90 miles an hour, the frame of the apparatus is carried by a very powerful double spring which slides freely along the cable as far as to within 65 feet of the ground, at which point the diameter of the cable progressively widens and the double spring also is forced to widen, and then exerts a pressure upon the cable and, through its friction, gradually diminishes the velocity.

The experiments have shown that the pressure of the wind is notably less than that admitted up to the present. After they have been finished, this question, which has hitherto been very uncertain, will have made an important progress and have demonstrated once again the services that the Eiffel tower is capable of rendering to science.

Engineering Notes.

The North-Eastern Railroad of Great Britain has been experimenting with a new system of illumination for its railroad cars. The advantage of this system is that no wick is required, and there is a complete absence of smoke and smell. In this method gasoline is poured into a receiver which contains a specially prepared and patented absorbent block; this block absorbs the spirit, which in passing through it is vaporized. When the lamp is turned on, this vapor comes into contact with an ordinary incandescent mantle, and a brilliant flame of 50 candle power is obtained. One charge of the lamp furnishes enough gasoline vapor to last for eleven hours continuous light.

It is shown by the experiments of Dr. M. Ennslin (see Dingler's Polytechnisches Journal, Vol. 318, Nos. 50 and 51, 1903), that there exists a proportionality between the load and the elastic deflection up to a limit beyond which the latter will go on more slowly than the load. The total deflection, on the contrary, will increase more rapidly than the loads from a given value of the latter. It is shown that the coefficient of elasticity of the disks investigated is partly greater and partly smaller than the one of bars from the same material, this being most likely due to the following reasons: (1) The inaccurate knowledge of the longitudinal tension, as well as of the constants of elasticity, of the material in three perpendicular directions. (2) A singular state of internal stress, as due to the rolling process which is altered by annealing. (3) The influence of transverse strains on the deflection of the disk. Neglecting the latter would result in the coefficient of elasticity of the disk being found smaller than that of tension bars. Revising the theory of circular disks, he concludes that any objections which might be raised are incapable of exerting any material influence on the figures found by experiment. In order to establish a still more satisfactory accord between experiment and theory, the isotropy of the material should be more fully accounted for. The accuracy of the theoretical results within the limits of proportionality may anyhow be said to be sufficient from a practical point of view, but the author is not able to draw any conclusions with regard to the behavior of circular plates beyond these limits.

An interesting railroad relic, reminiscent of the first days of the steam locomotive, has been discovered in the north of England. The Liverpool & Manchester Railroad Company, the first public road constructed, it will be remembered, inaugurated a competition in the latter part of the twenties of the past century for a locomotive, in which Stephenson and other inventors participated. Three engines—the "Rocket," by Stephenson; the "Sans Pareil," by Hackworth, and the "Novelty," by Braithwaite and Ericsson respectively—participated in the trials that were carried out in 1830. As is well known, Stephenson's "Rocket" secured the award of $2,500 which was offered, as being the most suitable engine attaining a speed of 29 miles per hour. The "Sans Pareil" was second with a speed of 23 miles per hour, while the "Novelty" withdrew from the trials owing to the joints of the boiler giving way when the locomotive had traveled only three miles. Both the "Rocket" and the "Sans Pareil" are now preserved in the South Kensington Museum, but the "Novelty" mysteriously disappeared and was never found again until quite recently. It appears that Ericsson was so mortified by the failure of his conception, that he left it with his friend, Mr. Melling, who possessed engineering works located upon a space adjoining the Rainhill Station. These works were subsequently dismantled and the premises were occupied by the Rainhill Gas and Water Company. The "Novelty" was thus lost sight of, but it has now been recognized working as a stationary engine, the wheels having been removed for this purpose, and its identity thus somewhat disguised. Attempts are to be made to secure this third premier locomotive, and to place it alongside of its two contemporaries in the South Kensington Museum.

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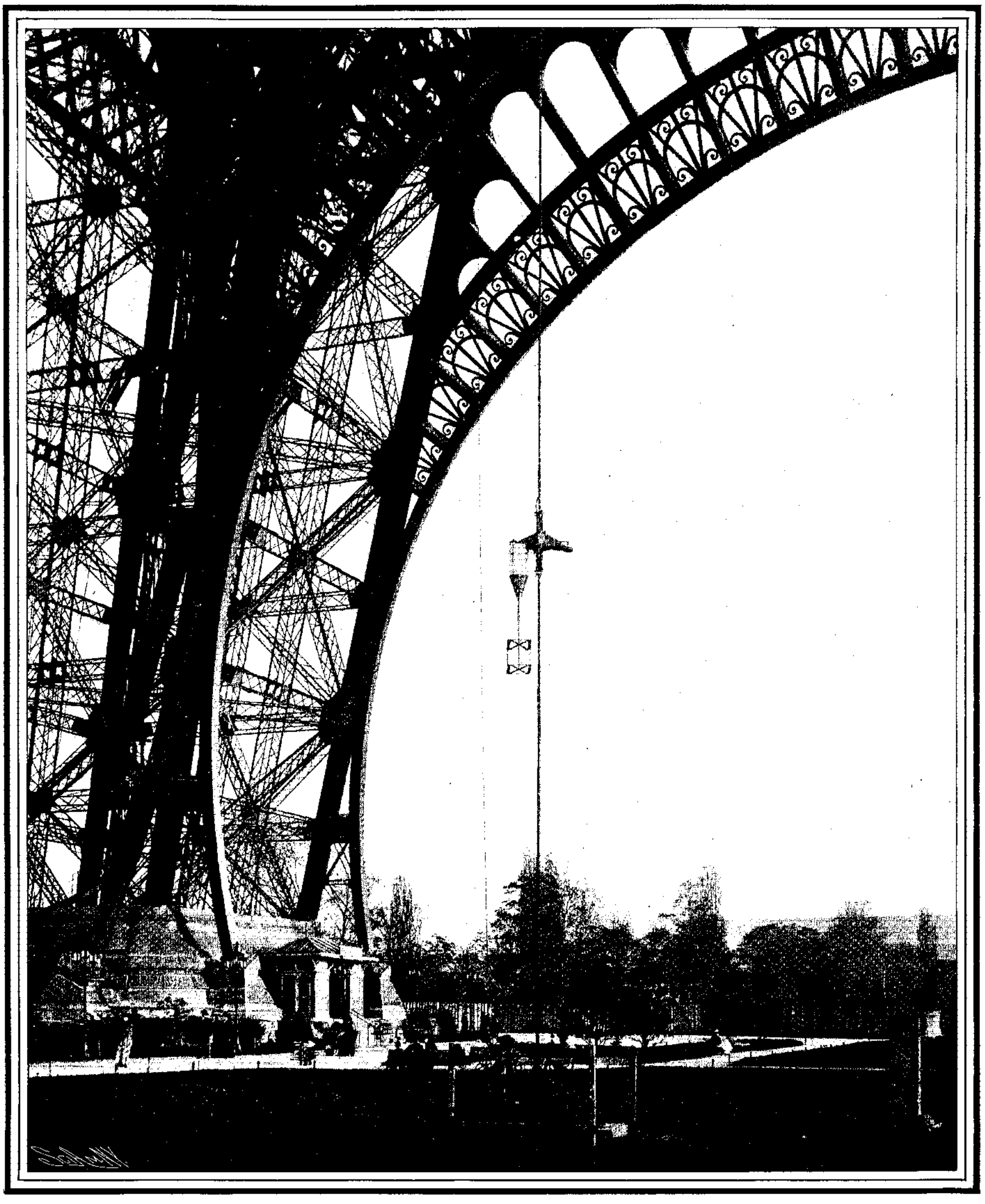

THE BASE OF THE EIFFEL TOWER, SHOWING THE APPARATUS FOR MEASURING THE PRESSURE OF WIND.—[See page 230.]