(*Continued from page* 3.)

to Europe in disgust. Perhaps the most persistently active of all the airship inventors is Lebaudy, who, with his new machine, No. 2, has made altogether some fifty ascents. To him is due the credit of having accomplished the longest continuous trip on record. The much-advertised airship contests at St. Louis proved to be a miserable fiasco. In view of the results it cannot be denied that the management. in placing a speed limit of not less than 20 miles an hour upon competitors, was guilty of a grave mistake; for it was certain beforehand that, in the present state of the art, no machine could be built with a reasonable expectation of complying with such a restriction. The only really creditable work done at St. Louis was the successful flights made by the Baldwin machine. Of the aeroplane we have heard comparatively little during the year. Baden-Powell has continued his gliding experiments, and is gathering much useful data for future work. The Wright Brothers, in this country, who in 1903 made the first successful flight with an aeroplane, self-propelled and carrying its operator, have recently made a flight, the particulars of which have not been given to the public. Mention should be made in this connection of the successful experiments made by the French and Italians with what are known on the Continent as "*ballons sondes*." These are small balloons furnished with self-registering meteorological instruments—barometers, thermometers, etc.—which are set free and rise to enormous heights. They contain a notice to the finder that on their being returned to the sender a specified reward will be given.

AUTOMOBILE AND MOTOR BOAT.

The past year has seen a greater development of the automobile, at least in the industrial sense, than any of its predecessors. Out of the motley variety of types, shapes, and sizes that were developed during the earlier growth of the industry, there have survived certain desirable types and makes which will probably be the standards for at least several years to come. The accepted type of racer is a machine of from 60 to 90 horse-power, with vertical cylinders carried above the front axle with a bevel-gear drive direct to the rear axle. The 24-horse-power tonneau touring car seems to be accepted as the maximum-powered machine for touring and general pleasure purposes. The possession of the wonderful track at Ormond Beach served for a while to bring the records for high speed to this side of the Atlantic, and Mr. Vanderbilt's record, made on a 90-horse-power Mercedes, of 1 mile in 39 seconds, and 50 miles in 40 minutes 49 4-5 seconds, must long remain as one of the most notable high-speed achievements in the history of the automobile. Very creditable was the performance of Rigolly, who, on a 100-horse-power Gobron-Brillié machine, covered the mile with a standing start in 53 3-5 seconds. The Gordon Bennett race, over a course 327.4 miles in length, was won by Théry, who made an average speed of just under 60 miles an hour for the whole distance. At the Ostend races Baras, on a Darracq machine, eclipsed Rigolly's performance by covering the mile from a standing start in 48 3-5 seconds. The supreme speed effort of the year was achieved in these races, when Rigolly covered the flying kilometer at a rate of 103⅓ miles per hour. America is rapidly becoming a strong competitor of Europe in the production of racing cars. Evidence of this is seen in the track records made by Oldfield late in the year, when he made the mile in 52 1-5 seconds and the 10 miles in 9 min. 12 3-5 sec., easily beating Théry, the winner of the Gordon Bennett race of 1904. The records on the race course find their counterpart in some excellent endurance performances on country roads, chief among which is the transcontinental trip from San Francisco to New York, made by two men in a 10-horse-power air-cooled runabout, in the short time of thirty-three days, which is twenty-eight days less time than was occupied in the previous fastest trip. The distance covered was 4,500 miles. Toward the close of the year the very successful Vanderbilt cup contest was inaugurated by a race on Long Island over a course on which the actual racing distance was 284.4 miles. The race was won by a Panhard 90-horse-power machine, which maintained an average speed of 52.2 miles an hour for the whole distance.

Closely allied to the automobile is the motor boat; for the latter owes its origin to an enthusiastic French automobilist, who conceived the happy idea of putting a high-powered automobile engine in a lightly-constructed shell, and directing the craft with a regulation auto steering wheel. The idea "caught on" at once, and out of this venture has developed the speedy craft of to-day. The events of the year were the race off Cowes for the Harmsworth cup, which was won by the French boat "Trêfle-a-quatre"; and the race for the gold challenge cup of the American Power Boat Association, won by the "Vingt-et-un." Mention should also be made of a race from New York to Poughkeepsie, which was won by a boat called the "XPDNC" in 5 hrs. 11 min. and 50 sec. at an average speed of 26.29 statute miles per hour. The "Onontio," a new American boat of 175 horse-power that was completed late in the year, on her trial trip covered the mile at a speed of 28.42 statute miles per hour. The improvement of the motors, particularly as to their reliability, has greatly stimulated the motor-boat industry, and apart from the interest which will be aroused by future high speed contests, there are indications that the cruising motor boat will ultimately rival, if it does not exceed, the sailing yacht in popularity.

WIRELESS TELEGRAPHY.

During the past year wireless telegraphy has continued to establish itself as an art of assured commercial value and practicability. The Marconi system in England, Italy, and to a certain extent in the United States, the Slaby-Arco Company in Germany and Russia, and the De Forest Company in this country have greatly extended their field of operations, and with one or other of these concerns the various governments have made some substantial contracts. De Forest has brought out a new telephonic receiver of great sensitiveness, which consists of a small metal cup filled with dilute acid into which projects a fine platinum wire, 38-1,000,000 of an inch thick. This cup and wire forms part of a local battery circuit which includes a telephonic receiver; and the electrical surgings set up in the receiving antenna, acting on the apparatus, intermittently interrupt the current in the local circuit and thus act on the telephone. Another twelve months has passed without our seeing a fulfillment of the promised transatlantic service of the Marconi Company; although we are assured that occasional experimental messages are passing between the Poldhu station and that at Glace Bay. We understand that Marconi, in common with all inventors, is chiefly occupied in the endeavor to solve the difficult problem of syntonizing, which has for its object the sending of messages exclusively to a particular station, without the possibility of being interrupted or read by competitive systems. Apparently this problem is to-day as far from solution as it was last year. Mention should be made in this connection of the Delany system of rapid telegraphy, in which the inventor has overcome the obstruction arising from the static capacity of the line, which acts to retard the current and produce an afterflow at the receiver. This difficulty is overcome by sending two short impulses of opposite polarity for each dot and dash of the Morse school. Prof. Majorama, in Italy, has brought out a new system of telephony, in which he makes use of a spark gap of the frequency of 10,000 per second. This frequency is disturbed and interrupted by the oscillations of the human voice at the sender, and the Hertzian waves are thus modified at the receiving station, so as to reproduce distinctly every word spoken in the transmitter. Another charming invention of the year is the telecryptograph, by which it is possible for the sender to dispatch his message by using an ordinary typewriter, the action of which serves to write a corresponding message on a typewriter attached at the other end of the line.

THE LARGEST WATER TURBINE IN EXISTENCE.

At a point on the St. Maurice River, some 84 miles to the northeast of Montreal, are located the beautiful cascades to which the Indians, seeing in them a resemblance to the glittering bead and quill work of the people, have given the name of "Shawinigan." The total descent of the water is 140 feet, and the site forms one of those ideal spots for hydraulic development, of which nature has made such abundant provision in North America. As if to render the task an inviting one to the locating engineer, nature has provided in the river just above the cascades a broad bay or upper lake, and just below the cascades, which turn through an angle of about 90 degrees, there is a second or lower lake. The bend in the river brings the upper and lower water levels within a short distance of each other, thus inviting the location of a power house at the bottom of the slope. From the south end of the upper lake or forebay, a canal 20 feet deep and 1,000 feet long leads to a point where the ground begins to fall through a vertical height of 140 feet in a horizontal distance of 500 feet. Here the canal is closed by a concrete wall, which is pierced by six outlets for as many penstocks, each 9 feet in diameter. Provision is made for such further extension of the wall and addition of the penstocks as future developments may call for. At present three penstocks are in position, carrying water to as many turbine wheels in the power house on the shore of the lower lake. Each penstock supplies a 6,000-horse-power, horizontal-shaft turbine, direct-connected to a 3,750-kilowatt revolving-field generator, giving a quarter-phase 2,200-volt 30-cycle current. The wheels run at 180 revolutions per minute, and provision is made for a 2½ per cent loss in the generators and a 15 per cent overload.

At the present time the capacity of the station is being enlarged by the addition of a fourth turbine, which is now being installed by the I. P. Morris Company, of Philadelphia. This turbine is the largest which has ever been constructed. It has a capacity of 10,500 horse-power, and its huge dimensions are well shown by the photograph on our front page, which was taken early last October, after the machine had been erected in the shops. It is of the horizontal-shaft, inflow type, with spiral casing and a draft tube on each side, through which the water discharges outward from the center. The water enters the turbine through the intake, 10 feet in diameter, at the bottom of the turbine. It flows around and fills the outer special tube, and then passes in radially through an annular gate, and through the wheel, and, diverging, finally discharges right and left through two large draft bends, one on either side, of which one is shown in the photograph. In these bends are situated the bearings for the shaft, one of which is clearly visible in the view shown. It will be noticed that although the diameter of the intake is 10 feet at the bottom, the sectional area gradually diminishes as the water passes around the tube, the diminution being proportionate to the amount of water that flows in through the wheel as its circumference is traversed.

The dimensions of this vast machine are as impressive as the photograph. It is 30 feet from base to top; 22 feet wide over all, and 27 feet from center to center of the two shaft bearings. Its total weight is 364,000 pounds. The shaft, which is of forged steel, is solid and weighs 10 tons. It is 32 feet 3½ inches long, 22 inches in diameter at the center, and tapers to 16 inches on the generator side and 10 inches diameter on the other side. The runner or wheel, which is the rotating part of the turbine, is of bronze, and weighs 5 tons. The quantity of water used when the turbine is operating under full load is enormous, no less than 400,000 gallons passing through per minute. Just what this figure amounts to, will be understood when we state that it represents a river 100 feet wide, 9 feet deep, and flowing at the rate of 60 feet per minute. In spite of its size, this huge machine was built in no less than five months, the contract being signed May 19, 1904, and the photograph taken October 2 of the same year.

The present output of power from the Shawinigan station is 22,500 horse-power, and of this about 10,000 horse-power is transmitted 84 miles over long-distance lines to the city of Montreal, where it is used for street railway, electric lighting, and general power purposes. The remainder is taken by local users for similar purposes and for electrolytic processes. The current is stepped up at Shawinigan from 2,200-volt quarter-phase to 50,000-volt three-phase. The transformers were so designed that they may, if desired, be operated at 56,000 volts pressure. It is a fact worth noting that the wilderness of five years ago in the neighborhood of the falls has been transformed into the substantial city of 5,000 inhabitants of to-day.

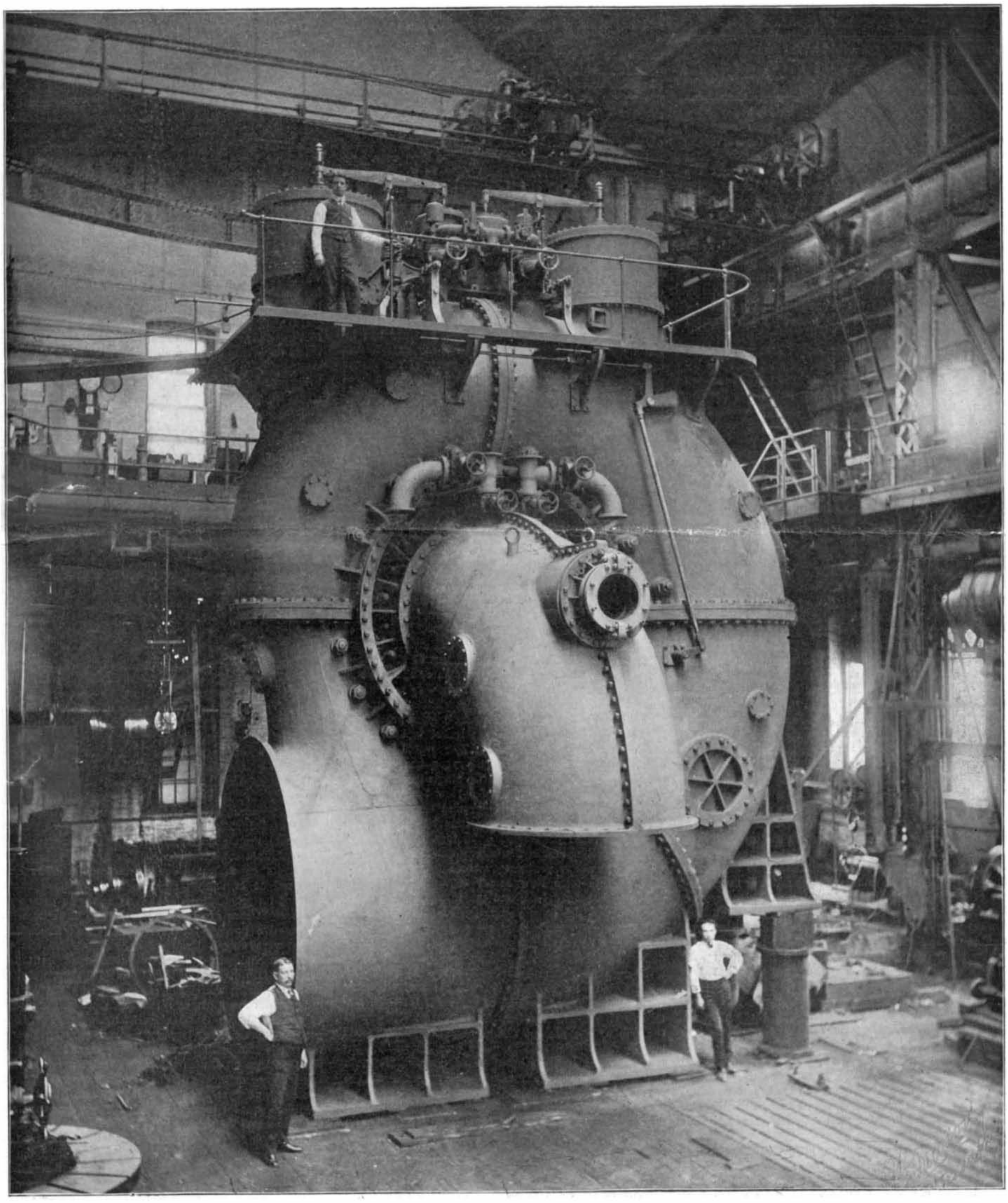
The Current Supplement.

The current SUPPLEMENT, No. 1514, opens with a splendid article by Howland Gasper on duck raising, which is a large and lucrative industry on Long Island. For the first time the whole history of one of the great national sites of Egypt has been opened before us, dating from the beginning of the kingdom and ending with almost the last of its native kings. The meaning of this revelation is tellingly recounted by the well-known Egyptologist, Prof. Petrie, in an article entitled "The Ten Temples of Abydos." John A. Morris presents an interesting study of the spider. Articles of no great length but of much practical value are those on "Tarring Roads to Prevent Dust and Aid in Their Preservation," "Compressed Air in Hoisting," and "Electric Igniters for Gas Engines," the last by the late George M. Hopkins. Prof. Ritchey's excellent monograph on the "Modern Reflecting Telescope and the Making and Testing of Optical Mirrors," is continued, the present installment dealing with polishing and polishing tools. Sir Oliver Lodge's recent discussion of "Lightning Pictures" is reviewed. The Paris correspondent of the SCIENTIFIC AMERICAN writes on the Paris Automobile Show.

A new type of combined fire and salvage float has been constructed for use on the Manchester Ship Canal. The craft is of great power for both the functions for which it has been designed. For fire-extinguishing work the vessel carries three large monitors, each capable of throwing a solid 2½-inch jet of water to a maximum height of 250 feet at full pressure, and there are also twelve outlets for hose connections, each with main gage instantaneous couplings. The monitors are placed forward, amidships, and aft, respectively, and each is fitted with wheel and worm gear so that the jet can be directed at any angle. A total volume of 3,000 gallons of water can be discharged per minute. For salvage purposes the pumps have a discharging capacity of over 18 tons of water per minute. The speed of the craft is eight knots per hour. The float has been designed more especially for coping with conflagrations among the great warehouses on the banks of the canal, wherein is stored highly inflammable freight.

SCIENTIFIC AMERICAN

Vol. XCII.—No. 1. [ESTABLISHED 1845.] NEW YORK, JANUARY 7, 1905. [8 CENTS A COPY $3.00 A YEAR.



Weight, 364,000 pounds. **Height,** 30 feet. **Weight of Wheel,** 5 tons. **Weight of 22-inch Shaft,** 10 tons. **Intake,** 10 feet diameter. **Amount of water passing through per minute,** 400,000 gallons. **Built for the Shawinigan Power Station, Canada.**

THE LARGEST WATER TURBINE IN EXISTENCE. [See page 6.]