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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

RETROSPECT OF THE YEAR 1904.

Any retrospect of the year 1904 that fails to include a reference to the stupendous struggle that is being waged by sea and land in the Far East would be guilty of a large omission. This is true, even when the point of view is taken, as in the present case, from a standpoint purely scientific. Much as we could wish that science were first and last the handmaiden of peace, and that the growth of knowledge and the progress of invention and discovery meant the gradual extinction of the arts of war—we cannot shut our eyes to the fact that much of the interest in the present conflict, and all of its grim surplus of carnage, is directly traceable to the deadlier weapons that our twentieth century science has placed at the disposal of the combatants.

Most sincerely does the SCIENTIFIC AMERICAN regret the fact, as disclosed by the present war, that the refinements of science, instead of mitigating, as we had many of us fondly hoped they would, the horrors of war, have multiplied them. Contrary to expectations, the struggles on land have proved that the awful destructiveness of modern implements of war, so far from restraining the opposing forces and causing them to fight at ranges at which the magazine rifle and the machine gun are not so deadly, has rather thrown them into the close embrace of death struggles, in which the hand-grenade and the bayonet are the preferred instruments of slaughter. The dream of the philanthropist that science had made modern warfare so shocking and terrifying as to render its continuance impossible, fades pitifully away in the presence of that awful panorama at Port Arthur, where the bodies of brave men lie rotting by the thousand on the snow-covered slopes of the fortifications, truce for burial being deemed incompatible with the exigencies of successful warfare. All of which goes to prove that in seeking for a cure for the madness of war, we must look rather to moral than material forces. There is a hint in this, surely, in the fact that while Russia and Japan are locked in a struggle to the death, the nations of the world, among whom is included one of the parties to that struggle, have agreed to assemble in another Peace Congress at the Hague.

RADIO-ACTIVITY.

Although considerable experimenting has been done with the radium group of minerals, it can hardly be said that the year's investigations have added much to our knowledge of the cause of radio-activity. Not a little speculating has been done as to the origin of the radium emanations, some of it mildly amusing, and some of real value. Prof. Rutherford, who has probably been the most indefatigable radium investigator of the year, if one may judge by the frequency of his contributions to the scientific press, has published a most plausible theory of the hypothetical disintegration of the radium atom, and reinforced his assertions by experimental proof, wherever that has been possible. Many of the physicists who have been working in the field have so far extended their researches that many of the substances of common life may be considered sources of rays. Notable among these men is Simpson, who has made very valuable tests of atmospheric radio-activity at high altitudes. Tommasina, too, has attracted not a little attention to himself by his discovery of the so-called "pyro" rays, given off by red-hot metal wires. These "pyro" rays bear a striking similarity to the radium emanations and like them may be classified into the well-known alpha, beta, and gamma rays.

No doubt the most puzzling physical work of the year was that carried out by Prof. Blondlot in endeavoring to convince a doubting scientific world of the existence of his N-rays. The controversy which has raged over the problematic manifestations of Welsbach burners, Nernst lamps, flint, vibrating sonorous bodies, and even such ordinary things as paper, is not likely to be settled until Blondlot consents to work with some skeptical opponent in the now famous Nancy laboratory where the rays were first discovered. Charpentier, who has assiduously advocated the existence of the N-rays, has outdone, from the standpoint of sensationalism, anything that Blondlot himself has announced. He has proclaimed in no less an organ than the staid Comptes Rendus that the nervous system of the living organism can be mapped out by means of a fluorescent screen, because the nerves have the peculiar property of rendering the N-rays unusually luminous. That it should thus be possible to measure the force of muscular contraction, to note the activity of the brain, and indeed, to trace by substances rendered phosphorescent, the general arrangement of nerves in the human system, seems an extraordinary feat.

Prof. Wood of Johns Hopkins University has made probably the most thorough inquiry into the subject, and has come to the conclusion that even the photographic proof offered by Blondlot must be rejected, because the exposures were not timed with scientific accuracy. It must be confessed, however, that Prof. Blondlot, according to information he has supplied to the editor of this journal, has repeated his photographic experiments with instruments more precise than those which Prof. Wood has so justly objected to, with the result that in his opinion the existence of the N-rays is more firmly established than ever. Although we have ourselves been inclined to give Prof. Blondlot the benefit of the considerable doubt there is in this matter, because of the unusual skill in observation that seems necessary, still we must confess that the N-rays must be studied with more exact means than those adopted by Blondlot, before they can take their place with radium, thorium, and pyro rays as new discoveries. In Great Britain and Germany, the existence of these doubtful N-rays is boldly denied. At the University of Glasgow seven skilled observers were unable to note any of the characteristic phenomena of the rays. In Germany, Prof. Lummer has ingeniously shown that many of the N-ray experiments can be imitated without employing any of the means prescribed by Blondlot, and that the effects observed may be referred to processes taking place in the eye itself. On the whole, the best that we can do is to place a question mark beside the N-rays and hope that the coming year may end a debate over which too much ink has been spilled.

CIVIL ENGINEERING.

Probably the most important event in the world of civil engineering during the year was the opening of the Rapid Transit Subway in this city. While this is not by any means the first subway built to accommodate the passenger traffic of a large city, it is certainly the first attempt to provide a genuine express service over a four-track tunnel road. The system has been in operation long enough to prove that it is possible to run an underground service of fast trains under short headway with a minimum of risk and a maximum of punctuality and general comfort—all below the surface of the ground and entirely independent of street traffic. Its success has sounded the doom of the elevated railway, as such, and most of those who read these lines will see the day when every elevated structure will be removed from our streets, and when practically all the main avenues of surface travel will be duplicated by a system of electrically-operated subways constructed beneath them. This year has seen the completion of the first of the two single-track tunnels, which will serve to connect the New Jersey surface trolley system with the underground system in New York. The second or northerly tunnel is making unexpectedly rapid progress, thanks to a new shield of excellent design, and is now nearly one-half completed. Work is in active progress on the Pennsylvania Railroad tunnels from New Jersey to Long Island; the shafts have been driven, and the tunnel excavation is under way. The huge excavation at the site of the terminal station is making fair progress; but it must necessarily be many months before it can be carried down to a uniform depth of forty feet below the street level over an area measuring 500 feet in width by 1,800 feet in length. Toward the close of the year the plans were made public of the large terminal station to be built by the New York Central Railway at the site of the present Grand Central station. This building will be unique in many particulars. It contemplates the entire separation of the express from the local service, the former being handled on the higher level of the station, on which there will be no less than forty-two parallel stub-tracks, and the local service on a lower level, about forty feet below street grade, where there will be a number of stub-tracks and a loop, the latter enabling suburban trains to be run through the terminal without switching. The station building proper will cover a block of ground measuring from 300 to 625 feet in width by 680 feet in length, and it will include a vast concourse 160 feet in width, 470 feet in length, and 150 feet in height. The operation of the trains in the station, the yard, and for forty miles of the main lines, will be by electric power, which will be furnished from two 40,000-horse-power central stations, located one on the Hudson River, and one on the East River. The past year has seen the opening of the unique system of freight subways, which has been built below the business portion of the city of Chicago. It includes a series of trunk lines running beneath the principal streets, with feeder lines extending below the cross streets, whereby freight may be taken from the terminal stations of the great roads that center in Chicago direct to the shipping floors of the various business houses. Twenty miles out of the sixty miles of tunnels contemplated by this scheme have been completed. Limitations of space prevent any lengthy reference to the extension of the subway systems in the leading cities of Europe. The power station at Chelsea, London, the second largest in the world, built for the operation of those underground roads in London which were formerly operated by steam, is approaching completion; and excellent progress has been made in the construction of the various deep tunnel roads that are under construction below that city. Work has also been prosecuted vigorously on the ambitious scheme of subways laid out below the city of Paris; and care is being taken, both in the construction of station exits, and of the rolling stock, to provide against a repetition of the loss of life by fire and suffocation which occurred last year. Although several bridges that will be among the largest in the world are under construction, none of them have been opened during the past twelve months. These include the monumental bridge at Quebec, crossing the St. Lawrence, which when completed will contain the longest span, 1,800 feet, of any bridge in existence; the cantilever bridge over the East River, at Blackwell's Island, which includes two notable river spans, one 984 feet long, and the other 1,182 feet in length; and the Manhattan suspension bridge over the East River, with a main span of 1,470 feet and a suspended floor of 120 feet in width. The piers and anchorages of the former bridge are completed, and the erection of the steel work is about to begin. Of the Manhattan suspension bridge, than which there is not a great engineering structure in the wide world more urgently needed, nothing has been completed beyond the masonry piers, and three years of valuable time have been lost as the result of this great work being made the mere sport of municipal politics. The preliminary investigation of the Panama Canal Commission has resulted in the agitation of the question of building a sea-level canal, as originally planned by De Lesseps. The surveys have shown that it is possible to divert the floods of the Chagres River to the Pacific by cutting an eight-mile tunnel through the divide; and although a sea-level canal will cost fifty per cent more, and take twice as long to build, as a canal with locks and a 90-foot summit level, the indications are that this will be the plan finally accepted.

STEAM AND ELECTRICAL RAILROADS.

The statistics of the steam railroad system of the United States show that over 4,000 miles of new road was built last year, bringing the total up to the remarkable figure of about 207,000 miles, on which the annual traffic receipts amount to nearly $2,000,000,000, and the net receipts to nearly $700,000,000. Apart from the pending introduction of electric in place of steam haulage on trunk railroads, there is nothing strikingly new to record, either in the construction of the roadbed or in the equipment of our railroads. The really stupendous work of relocating and reconstructing the western transcontinental roads, and, to a less extent, some of the eastern roads, has been prosecuted during the year, though on a more moderate scale than characterized the year preceding, the Pennsylvania system in particular having greatly reduced its expenditures for reconstruction. The size and weight of rolling stock appears to have about reached its practical limit, at least as far as passenger and freight cars are concerned. Not so however with the motive power; for at the St. Louis Exposition there were shown two freight locomotives, one of which, a Baldwin tandem-compound type built for the mountain division of the Santa Fé system, weighed 287,240 pounds; while the other, built by the American Locomotive Company for the mountain division of the Baltimore & Ohio Railroad, weighed 334,500 pounds. The coming type for express passenger service is the four-cylinder, balanced compound, either of the De Glehn type, with the pairs of high-pressure and low-pressure cylinders driving on separate axles, or of another type, that finds much favor, in which all four cylinders connect to a single axle. The former system is represented in this country by the Cole engine, as used on the New York Central, and the latter by the Baldwin type, as built for the Chicago, Burlington & Quincy Railroad. The speed of passenger trains has accelerated somewhat during the year, but it has evidently about reached the limit, at least under steam traction. In the speed and number of trains run the English and French services are greatly in advance of ours in the United States, although there are no trains in Europe that have so high a scheduled running speed as those that are put in service between Philadelphia and Atlantic City during the summer season. As the result of the construction of more powerful locomotives for their express trains, the English railroads have again taken the lead in fast running, for they now maintain in regular service a total of fifty-three daily trains scheduled to make a speed of 55 miles an hour and over from start to stop, the speeds ranging from 55 miles to 61.7 miles per hour. France has a total of thirty-five daily express trains with schedule speeds of from 55 to 60.8 miles per hour. Mention should be made of the run on the Great Western Railway, England, made during the year, when a train took the American mails from Plymouth to London, a distance of 246¾ miles, at an average speed of 65.49 miles per hour for the whole journey, the last 36 miles being covered at a rate of 79.17 miles per hour. The great weight of American express trains prohibits any such speeds as these in regular everyday service, but with the advent of electrical traction on our trunk railroads it is probable that we shall take the lead in express service.

This brings us to the question of the application of electric traction to the trunk lines, not merely for their suburban service, but for long-distance travel between widely-separated centers. Pioneer work on a most ambitious scale has been begun by the New York Central in the electrifying of its terminal station and suburban traffic. Undoubtedly the most interesting feature of this work is the fact that the express service will be operated electrically for a distance of forty miles out of New York; and upon the results obtained with the powerful electric locomotives now being built at Schenectady will depend, to an extent that cannot just now be definitely stated, the question of the extension of electric traction over such stretches of road as lie between New York and Chicago, Boston, Pittsburg, and Washington. In this connection mention should be made of the competitive trials now being carried out in Germany between steam and electric traction over the Berlin-Zossen stretch of road, on which a speed of 131 miles an hour was reached by an electric car in 1903. Several high-speed express locomotives of special design are being tested; but up to the present time there have been no results that would give reason to believe that for hauling heavy trains at speeds of 80 to 100 miles an hour the steam locomotive can compete with electric traction.

On the other hand, the results already obtained during the experimental runs of the New York Central electrical locomotive on a six-mile stretch of their track near Schenectady are very satisfactory. The trial track is only six miles in length, and consequently there is not time for the locomotive to reach the limit of its acceleration when hauling trains of different weights; but the data thus far secured prove that this electrical locomotive has all the powers of rapid acceleration which is one of the best features of this form of traction. Its total weight is 95 tons; its maximum horse-power, 3,000; and the maximum drawbar pull is 32,000 pounds. It is of the gearless type, that is to say, the armatures are mounted direct on the axles, and the field magnets are rigidly connected to the frame. Already, in the course of the tests, a speed of 63 miles per hour has been reached with an eight-car train, and 72 miles per hour with a four-car train; and in the starting test a speed of 30 miles per hour has been reached in 60 seconds with an eight-car train, weighing with the locomotive 431 tons, which is an acceleration of one-half mile per hour per second. With a four-car train weighing with locomotive 265 tons, the acceleration was at the rate of 0.8 of a mile per hour per second. If we remember that this locomotive was built to do certain work and no more, we can see what possibilities of increase in the weight of trains and in the running speeds exist in the electric locomotive. This engine weighs 95 tons, and can possibly develop a maximum horse-power as high as 3,500. It would be quite feasible to build a locomotive for high-speed service, of 5,000 horse-power and 125 tons weight, that would not overtax the track and bridges. However, if the New York Central venture leads to the general electrification of the trunk road for long distances, it is probable that the Sprague system of multiple-control, with the motors on the car axles, will be preferred. Meanwhile the trolley road systems throughout the country are gradually approaching the steam railroads in the solidity of their tracks, the size of their rolling stock, and the general comfort of travel. Already on interurban roads the electric sleeping car and the electric dining car have made their appearance, and are giving good satisfaction.

MERCHANT MARINE.

There are several respects in which the year just closed is a notable one in the annals of the merchant marine. In this country we have seen the putting into commission of the "Minnesota," the first of two huge American-built freight and passenger steamers of the type that is now becoming so generally popular. This vessel is 630 feet long, 73 feet broad, and 56 feet in molded depth, with a displacement at a draft of 36½ feet of, say, 35,000 tons. These two vessels will ply on the Pacific between Seattle and Oriental ports. Another notable vessel of the same type is the "Baltic" of the White Star Line, which made her maiden trip to this port during 1904. With a length of slightly over 725 feet, a beam of 75 feet, and a molded depth of 49 feet, this vessel has a total displacement at maximum draft of 40,000 tons, and she is at present, on every point of comparison, the largest ship in the world. The most important event of the year, perhaps, was the recommendation of the expert commission of the Cunard Company that turbine engines be installed in the two new Cunarders, and the letting of the contract for building these vessels, each of which will cost about six and a half million dollars. The money for their construction is loaned by the British government, which has the privilege of taking them up at short notice for use as armed cruisers. The latest authentic figures regarding the dimensions of these ships are as follows: Length over all, 790 feet; beam, 87½ feet; molded depth, 60 feet; horse-power, 75,000, distributed among four shafts. The speed will be 25 knots an hour; but judging from the excellent results obtained in recent vessels propelled by turbines, it is not unlikely that 26 knots will be reached on the trial trip. The year has seen the launch of the "Victorian," the first ocean liner to be equipped with turbines; and the vessel will make her maiden trip some time during the present year. Mention should also be made of the passage of the turbine-propelled freight and passenger steamship, the "Loongana," from Glasgow to Australia in thirty and a half days, the speed varying from 16 to 18 knots an hour. The turbines showed superior economy, and an all-round greater efficiency in service of this character over the ordinary reciprocating engines.

NAVAL AND MILITARY.

The lessons of the Russo-Japanese war are bound to have a marked effect upon the design of naval and military war material. Already, indeed, the naval campaign has shown its effect in the latest designs for warships authorized by various governments. It is not our intention at this time to give any *resumé* of the events and lessons of this conflict, and we shall reserve such matter for an article in our succeeding issue; but we may here point out that the tactics of the Japanese in electing to fight their naval engagements at extremely long ranges, frequently twice as great as that employed during the battle of Santiago, has shown the great value of high-powered ordnance, especially if it is mounted on a ship that possesses superior speed. It is the carrying powers of the big gun that render accurate and destructive long-range shooting possible; and if the ship that mounts the heavier artillery also possesses higher speed, she can choose her distance and play upon the enemy without his being able to make an effective reply. This was done by the Japanese, both in the engagement between battleships on August 10, and the engagement between armored cruisers a few days later. Consequently in the latest designs for British battleships of the "Lord Nelson" class, the 6-inch gun is abolished altogether, and the armament consists of four 12-inch and ten 9.2-inch, all carried in turrets on the upper deck, with a command of from 22 to 26 feet above the waterline. The new Japanese battleships have four 12-inch, four 10-inch, and twelve 6-inch guns. The latest Russian battleships now building in the Baltic are to carry four 12-inch and twelve 8-inch guns, and it is not unlikely that our next new battleship designs will provide for four 12-inch and ten 10-inch guns, all in turrets. The war has brought about some marked changes in the relative standing of the navies of the world. At its opening Russia stood third in a comparison on paper of naval strength. To-day she has lost seven battleships, four armored cruisers, seven protected cruisers, and several gunboats and destroyers, of a total displacement of about 175,000 tons; and these ships are the very cream of her navy, being of her latest construction. This loss forces her to drop from third to fifth position. If the Baltic fleet should be sunk or captured, which certainly is not unlikely, it will mean that her modern navy is absolutely wiped out of existence, and that she will have to begin *de novo* in the construction of another. At present the ranking of the naval powers is Great Britain, France, Germany, United States, Russia, Italy, Japan. If all the ships now building were completed, the order would be Great Britain, France, United States, Germany, Russia, Italy, Japan. There has never been a year in the history of the United States navy when so large an addition was made to our naval strength. This is due to the fact that many of the ships that were launched or put in commission this year should have been delivered from one to two years earlier. Among the launches are such fine vessels as the battleships "Louisiana" and "Connecticut;" the battleships "Georgia," "Nebraska," "Rhode Island," and "Virginia," of the "Georgia" class; the "California" and "South Dakota" and "Tennessee," of the armored cruiser class, and the protected cruisers "Milwaukee" and "Charleston." The speed trials of our later ships, particularly the armored cruisers, have been quite satisfactory, and altogether the progress of construction is far more rapid than it was two or three years ago. There has been no change of great moment in our naval ordnance, which continues to be manufactured on the patterns brought out during the administration of Rear-Admiral O'Neil as Chief of Ordnance. These guns have a designed velocity of 2,800 and 2,900 feet per second, on paper, and probably they are good for a service velocity of 2,700 feet per second. The service charges have been somewhat reduced by a general order sent out during the year. A new 45-caliber 12-inch piece is being built, which will be one of the most powerful 12-inch guns in existence. In speaking of the tendency to introduce heavier-caliber guns in the secondary battery, it is gratifying to reflect that this has been the practice in our navy ever since the period of reconstruction set in in the early eighties. The 8-inch gun has ever been a prominent weapon on United States battleships. It is probable that in the future our ships will settle down to three standard types—battleships of 16,000 to 18,000 tons, armored cruisers of from 14,000 to 16,000 tons, and swift scouts of 24 to 26 knots speed and of about 4,000 tons displacement. So swift has been the development of this new classification, that we have on our hands a miscellaneous lot of nondescript vessels, such as the 16-knot cruisers of the "Denver" class and the poorly-protected vessels of the "Milwaukee" and "Charleston" class, which it is safe to say will never be duplicated in our future building programmes. The torpedo boat has been shorn of much of its terrors during the present war. Vigilance, eternal vigilance, is the best defense against its attack, and its value, like that of the submarine, will in the future be rather moral than material.

STEAM ENGINEERING.

In a review of the most important events in steam engineering during the past year, we are confronted at once with the fact that the steam turbine looms up more strikingly than ever as the prime mover of the future in many specified lines of work. Elsewhere in this review we have spoken of its rapid strides in the merchant marine, for which it is admirably suited. As compared with the reciprocating engine, it is at a disadvantage when running under light loads, and this is particularly noticeable in marine work. The report, given out by the British naval authorities, of comparative trials of identical cruisers fitted with reciprocating engines against a similar cruiser fitted with turbine engines, showed that although at speeds of 14 knots and under the turbines were less economical, at speeds above 14 knots they showed a superior economy which, as maximum speed was approached, was simply astonishing. The maximum horse-power developed by the reciprocating engines was 9,600, and the maximum speed 22.24 knots. The turbine engines showed a maximum development of 14,000 horse-power, and a maximum speed of 23.63 knots an hour. The coal consumption at these speeds was 2.65 pounds per horse-power hour for the reciprocating engine, and 1.74 pounds per horse-power hour for the turbine engines. With 750 tons in their bunkers, the reciprocating engine cruiser could steam for 2,140 knots at 20 knots an hour, whereas the turbine-driven ship, at the same speed, would not exhaust her whole supply until she had covered 3,160 knots. The results obtained in land service have been equally favorable. The reliability of the type was shown in the 600-horse-power Westinghouse-Parsons turbine, that was exhibited in the Machinery Building at the World's Fair. This engine was started on June 20, and ran continuously at a speed of 3,600 revolutions per minute, and under great fluctuations of load, until it was stopped on December 2. On opening the machine it was impossible to detect any signs of wear whatever. In central station service, the turbine has now established itself as the accepted type of drive for the electric generator. The most prominent types in this country are the Parsons and the Curtis, and in Europe the Rateau. They are being built in units of as high as 11,000 horse-power each, and the new power stations to supply current for the electrical operation of the Pennsylvania and New York Central Railroad systems in this city are to be equipped entirely with steam turbines. In general reciprocating engine practice there is a tendency toward the use of higher steam pressures and the more extended application of superheat, hot forced draft, and other refinements for producing a high economy.

AERIAL NAVIGATION.

In that most fascinating and difficult field of experiment, aerial navigation, there has been much activity, but very few results of a satisfactory nature; that is to say, results that would lead us to regard the practical commercial airship or aeroplane as a possibility of the near future. Dr. Barton, whose aeroplane balloon is one of the largest and most powerful yet constructed, suffered from an accident which seems to have prevented his putting his airship to the test. Santos-Dumont, who entered his latest machine for the contests at the St. Louis Fair, was the victim of treachery at the hands of some unknown person at St. Louis, and carried his mutilated airship back

(*Continued on page 6.*)

(*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 103½ 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 "Trèfle-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.