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

REVIEW OF THE YEAR 1906.

Any review of the technical and scientific progress of the past year must necessarily take note of the truly phenomenal tide of prosperity, which has continued to rise steadily throughout the year, and shows at its close no signs of abatement. An analysis of the causes of this prosperity shows it to be founded upon the rapid and very thorough development of the abundant natural resources of the country, and among these, undoubtedly, the most important factor has been that of agriculture. Never before, in the history of the United States, have the farming interests been so favorably situated; and the excellent conditions are attributable to a series of abundant harvests, which have enabled the farmers not only to get rid of heart-breaking mortgages, but to restock their farms, purchase new and better machinery, surround themselves with more of the comforts and even luxuries of life, and in many of the States roll up very considerable bank deposits. The development of the mineral resources of the country, also, has been unparalleled; while in many of the leading branches of manufacture, factories and plants have been run to their full capacity, and many of them are several months behind their orders. Without going into details, it is sufficient to instance the steel industry, where conditions are such, that in the closing months of 1906, some of the mills, and particularly those devoted to the manufacture of steel rails, were so overloaded with orders that their total output up to the end of 1907 will barely serve to meet the demand.

CIVIL ENGINEERING.

Water Supply and Irrigation.—In the broad field of civil engineering, the prevailing activity is nowhere more evident than in the construction of costly works connected with water supply, irrigation, and the opening up of artificial waterways. New York city has witnessed the completion of the great Croton dam, with its capacity of 32 billion gallons of water, and the commencement of work on two additional reservoirs in the Croton Valley, above the dam, which will provide an additional storage of 25 billion gallons and serve to protect New York against a threatened water famine, tiding the city over until an ample supply shall have been guaranteed by the construction of the new Catskill reservoirs and the 90 miles of aqueduct by which the impounded waters will be brought within the city limits. During the year, the engineers of the Board of Water Supply so far completed their plans and estimates, that they are now ready for tenders, and it is probable that the actual work of construction will be in full swing before the year is far advanced. The plans contemplate the building of reservoirs, aqueducts, and filters sufficient to store, purify, and convey to New York city, 500 million gallons of water daily from the Catskill Mountains, at a total cost for the completed work of about $162,000,000. During the year the westerly basin of the Jerome Park reservoir was completed and put in service, and New York city was thus provided with an additional local storage and distributing reservoir, with a maximum capacity of 773,400,000 gallons.

The past year will ever be a notable one in the annals of irrigation, because of the vast system of works instituted by the government for the reclamation of the arid lands of the West. These works contemplate the construction of storage reservoirs which, in the size of their dams and the amount of water to be impounded, will form the most notable structures of the kind in the world. The Shoshone dam will be 240 feet in height above the bottom of the reservoir; the Pathfinder, 190 feet; and the Roosevelt, 230 feet; while the respective storage capacity of the three dams will be 19,863 million, 43,560 million, and 61,000 million cubic feet of water. Across the border, in the Province of Alberta, Canada, the Canadian Pacific Railway has completed another huge irrigation project, in which a valley 150 miles in length by 40 miles in width is being brought under cultivation. This block of irrigated lands alone is estimated to have room for half a million people, and it is a significant fact that 95 per cent of the present settlers in the district are Americans. In this connection mention should be made of the disaster in the Imperial Valley, where the great Colorado River broke through its banks into one of the irrigation canals, and the whole of its waters were diverted from the Gulf of California into the Salton Sink of the Imperial Valley. Thrust back into its channel by the construction of a 3,000-foot dam, the river has again broken through, and a further effort, estimated to cost $3,000,000, is at once to be made to close the breach and turn the river back into its natural channel.

Tunnels.—The past year has been remarkable for the activity which has been shown in the construction of tunnels and subways. It would seem, indeed, as though we were witnessing the close of the era of bridges and the opening of an era of tunnels; for the tunnel is taking the place of the bridge and viaduct, both for the crossing of waterways and in the provision of means of rapid transit in cities and thickly-populated districts. Limitations of space prevent any detailed mention of the work being done abroad in such cities as London, Paris, and Berlin, and we must confine ourselves to a recapitulation of the work planned and already executed in the city of New York. In the first place, mention must be made of the brilliant success attending the operation of the twenty miles of rapid transit subway in New York city. On a single day in the second year of its operation, this system recently carried over 600,000 passengers, and on that same day it should be mentioned that over 2,000,000 passengers were carried on the combined subway, street railway, and elevated systems of the city. The Rapid Transit Commission has authorized, and will shortly call for bids upon, new subways aggregating a total of 80 miles, whose total cost will reach $160,000,000. At the present time twelve separate tunnel tubes are being driven beneath the Hudson and the East Rivers. Five of these tubes have been put through and are being finished; two others will be connected in the opening months of 1907; and all of them will have been opened through by the close of the present year. A record in speed of construction was recently made on one of the tubes of the Hudson Company's tunnels, where the shield was advanced 72 feet in a single day. The large amount of valuable experience gained by our engineers has resulted in the use of improved methods and better machines. As evidence of this, it may be mentioned that the Hudson River tubes are now being driven through the mud by the displacement method, the material being thrust aside by the advancing shield, instead of being taken in through the doors in the shield. The Rapid Transit engineers are to be congratulated upon having solved, during the year, the important question of Subway ventilation. This was done by providing large ventilating openings between the stations, and air-cooling plants of generous capacity at the stations themselves. The temperature has been lowered on the hottest days from six to eight degrees, and this, coupled with the continual renewal of the air, has rid the Subway of the former stuffiness and unpleasant odor. Two vast tunnel projects have come again into public notice, one of which, the Behring Sea tunnel, can never, because of physical obstacles, get beyond the paper stage; while the other, the English Channel tunnel, will probably be made the subject of favorable legislation by the British government during the present year. The great Simplon tunnel was opened for traffic early in the year, and is now under successful electrical operation.

Bridges.—During the year excellent progress has been made in the erection of the great railroad and highway cantilever bridge across the St. Lawrence River, near Quebec. Although this structure is by no means the largest bridge in respect of its over-all length, it will contain the largest single span ever erected, the main span over the river measuring 1,800 feet between the towers. The total length from center to center of anchorage piers is 2,800 feet, made up of two 500-foot anchor spans, and two 562½-foot cantilever arms, extending over the river and carrying between them a central suspended span of 675 feet. The depth of the trusses over the main piers is 350 feet. The floor system will accommodate two steam railroad tracks, two electric car tracks, two highways for vehicles, and two sidewalks. The bridge is now more than one-half erected, and will be completed probably during the present year. In New York the Blackwell's Island cantilever bridge is being slowly erected; the Manhattan suspension bridge, thanks to political jugglery, seems to be practically at a standstill; while it is interesting to note that there is a revival of interest in the project for erection of a bridge across the Hudson River.

Armored Concrete.—The professions of architect and engineer overlap so broadly in these days, that we may be excused for speaking of the progress of armored concrete under the head of civil engineering. Indeed, the development of this new material of construction, or combination of materials, is proving to be fully as useful to the civil engineer as it is to the architect. In the first place it has served greatly to broaden the scope of masonry arch construction, the embedded steel rods serving to give that tensional strength which uneven loading renders necessary in all arches, and particularly those of long span. For subway work it has taken the place of the steel column and concrete arch for walls and roofs, and when the steel is judiciously distributed it is doing good service where formerly the massive steel column and the plate girder had come to be the standard construction in pier and viaduct work. The too frequent failures of armored concrete are always traceable either to poor design or careless workmanship—never to any inherent fallacies in the principles of construction.

Panama Canal.—The past year must always be notable in the history of the Panama Canal as having witnessed the completion of the era of preparation and the commencement of that of active construction. The year opened under a cloud of many discouragements and uncertainties; but as the months have gone by, order has gradually come out of confusion; a definite plan has been outlined; an organization perfected; experience as to the best methods and probable costs acquired; and the great work has at length been thrown open to competitive bidding. The two most important events of the year were the very exhaustive and able Senate investigation covering every possible feature of the enterprise, and the technical investigation by the International Advisory Board. The Isthmian Canal Commission has committed the country to the construction of an 85-foot, high-level, lock-and-lake canal, and it is upon this plan that bids are requested. The work will be executed along those well tried lines which have proved so successful in the building of our great railroads and other large engineering works. It will be built by contract on the percentage basis and under the supervision of the Canal Commission's Chief Engineer—a plan of which the SCIENTIFIC AMERICAN has always been an earnest advocate.

NAVAL AND MILITARY.

The most important naval event of the year, as affecting naval construction, was the successful trials of the battleship "Dreadnought." The world's attention was riveted upon this vessel, mainly because she was the first battleship to be built embodying the lessons of the Russo-Japanese war, and also because the British government had avowed its intention of establishing a record in rapid construction. The "Dreadnought" is notable for the facts that she was built in less than eighteen months; that she is armed as to her main battery exclusively with 12-inch guns; and that she is driven by turbine engines. The ship developed a speed of 21½ knots, and in her gun trials stood the simultaneous discharge of her 12-inch guns without structural injury. That the turbine engines have given great satisfaction is proved by the official announcement that henceforth all the larger British warships will be driven by this type. Other nations must now follow suit; for even Germany, which has always discredited the turbine, is reported, on good authority, to have decided upon its adoption. The Japanese have launched their own "Dreadnought" in the "Satsuma," a 19,200-ton ship carrying four 12-inch and twelve 10-inch guns in the main battery, and twelve 4.7-inch guns in broadside for repelling torpedo-boat attack. Germany has planned a 19,000-ton vessel which is to carry fourteen 11-inch, 50-caliber guns of high velocity, and a penetrating power approximately equal to that of the 12-inch piece carried by other powers. Our own government contemplates an even larger ship of 20,000 tons displacement, carrying ten 12-inch guns, which, being all arranged on the center line of the ship, will be all available on either broadside. In the weight and distribution of her armor and in the provision of internal bulkhead defenses, this vessel will be superior to anything built or planned by other navies. The armored cruiser seems at last to have merged in the battleship, as witness the three new British 25-knot cruisers of the "Inflexible" type, carrying eight 12-inch guns in four turrets; the new Japanese cruisers of the "Tsukuba" type, of 16,000 tons displacement, which will carry four 12-inch and eight 8-inch guns in the main battery; and the new Russian "Rurik," mounting four 10-inch and eight 8-inch guns. If things continue to go the way they are moving now, the future warship will be a cruiser-battleship of 20,000 tons or more displacement and 22 or 23 knots speed, carrying from eight to twelve 12-inch guns, and a numerous battery of 4.7 or 5-inch for repelling torpedo attack.

Progress in the United States navy has been exceedingly satisfactory during the past year. There have been completed or put in commission all the powerful battleships of the "Connecticut" and "Georgia" classes, and the equally effective cruisers of the "California" class, and in these vessels we possess homogeneous fighting ships which are equal, if not

superior, to the best squadrons that could be brought up against them by foreign navies. If we except the "Dreadnought" and possibly the ships of the "Lord Nelson" class, the latter armed with four 12-inch and ten 9.2-inch guns, there is, indeed, no squadron of foreign ships to match the five vessels of the "Georgia" class, and certainly there are no individual ships of the all-round excellency of the "Connecticut" and "Louisiana." Two ships of the new "Dreadnought" type have been commenced, namely, the "South Carolina" and "Michigan," which on 16,000 tons displacement will carry eight 8-inch guns, all available on either broadside. As things are now trending among the navies, the future types will resolve themselves into battleships of 20,000 tons displacement or over; fast scouts of 3,000 to 5,000 tons and 25 knots speed, and torpedo-boat destroyers of 25 to 35 knots—the British have a 36-knot turbine-driven destroyer now under construction. A notable event of the year was the towing of the large floating drydock "Dewey" from Hampton Roads to Cavite in the Philippine Islands. Mention should be made of the excellent records of our various ships at target practice, which place us abreast, if not ahead of, the world in accuracy of fire. The growth of our navy was strikingly exemplified in the assemblage at Oyster Bay last summer, for review by the President, of the vessels of our North Atlantic fleet—a combination which, as was remarked at the time, was approximately equal in powers of attack and defense to the combined Russian and Japanese fleets that were engaged in the battle of the Sea of Japan.

There have been no developments in guns or armor during the past year that call for special mention. The armor-piercing projectile seems to have a slight advantage over face-hardened armor, but both are of very high quality. The development in guns has been in opposite directions; for while there has been a tendency abroad to increase velocities, the guns on the "Dreadnought" having a service velocity of 2,900 feet per second, the velocities of our naval guns have been reduced to 2,700 feet per second, while the future guns for our army coast defense are to return to the 2,000 or 2,100 foot-second velocity of ten or twelve years ago; the weight of the guns and projectiles being increased, in the case of the army gun, to compensate for the lower velocities. Mention should be made of the government tests of the 6-inch Brown wire gun which, with a pressure of 32 tons in the powder chamber, delivered its shell with a muzzle velocity of 2,740 feet per second and a muzzle energy of 10,295 foot-tons; which, by the way, is more than double the energy of the naval 6-inch gun above referred to. Our army and navy ordnance officers consider that these reductions in velocity are necessary in order to prolong the life of the gun. The army 12-inch guns become so reduced after firing 60 rounds as to lose their accuracy entirely.

WIRELESS TELEGRAPHY.

In the past twelve months wireless telegraphy has maintained its hold on the interest of the public, because of a number of interesting conditions, scientific and otherwise. Early in the year both Fessenden and De Forest made extensive essays to give us cableless telegraphy; but the result of their experiments, like those previously made by Marconi, were futile in so far as transoceanic work is concerned, and the submarine cable still holds its own. The constant litigation that has been waged between the opposing interests over patent rights had awaked the hope that an end might finally be reached in which the limitations of the various claimants would be clearly defined, and the question decided whether or not the Marconi company was to have an absolute monopoly on wireless transmission. One of the untoward features, at least on this side of the Atlantic, is the sale of their securities by several of the largest companies. The majority of the companies that are engaged in this practice are over-capitalized, and have not earned, and are not now earning, dividends. The promoters of these companies have in many instances led the public to believe that the system they advocated was perfect, and that a means of selectivity had been evolved. For this and other reasons the transmission of messages overland has not been as much of a success as some of the more optimistic of the quarter of a million shareholders had hoped for. The interior stations scattered throughout the country have been utilized to educate the masses in the possibilities of wireless telegraphy rather than for the interchange of telegraphic business. Among those who are engaged in the practice of the art—and this includes not only numerous operating companies, but the armies and navies of the world as well—the lack of selectivity has brought about a state of affairs that borders on chaos, for only one or two stations in the active zone of radiation—and this often means a radius of a thousand miles—can send at the same time.

To circumvent this extinction of messages by interference and other difficulties that arise from it, was the purpose of the International Wireless Telegraph Conference, which convened within the last two months in Berlin. But even if all its recommendations were adopted, the fundamental problem would in no wise be solved. It is interesting to note in this connection that at this conference Poulsen exhibited his newly-developed selective wireless telegraph system, which he believes, and which we all hope, will be commercially selective instead of theoretically selective, as has been the case of its predecessors. Should the new system ring true, then the past year will go down in the history of wireless as the most progressive period since the beginning of the art.

STEAM AND ELECTRICAL RAILROADS.

Judging from the events of the year, the time is still far removed when the steam locomotive will have been crowded off the great system of railroads which it has brought into existence, and on which it has been so long supreme. For long-distance service it still remains the most economical and convenient means of traction, and particularly for the working of heavy freight traffic. The most successful competition in passenger service is that offered by the high-speed interurban lines, on which large and powerful cars, equaling in size and comfort the steam railroad cars, are being run at high speeds in successful competition with through steam trains. Gradually, the track and general equipment of these roads are being brought up to the standard of the steam roads. It is probable that their growth and successful operation will prove the most powerful factor in abolishing the steam locomotive, and breaking up into smaller units the long ten- and twelve-car trains of our present railroad service. Meanwhile, the work of equipping the terminal stations and suburban lines of the steam railroads proceeds apace. The New York Central Company has already made a partial opening of its temporary terminal at Forty-second Street and its electrical suburban lines. The power station at Port Morris is completed, and that at Yonkers practically so. The New Haven Railroad has nearly completed its Cos Cob power station, and has erected the costly lattice structure of its overhead trolley line, which consists of a pair of posts and a connecting overhead girder, spanning the four-track road at every 300 feet of its length. The company is now engaged in stringing the four trolley lines over this electrical zone, which extends from Woodlawn to Stamford. It is expected that the electrical zones of both the New York Central and the New Haven systems will be in full operation by the spring of the present year. The Pennsylvania Railroad Company is making fair progress with the excavation of the site for its terminal station on Manhattan Island. Merely to prepare the site involves the excavation of between 2,000,000 and 3,000,000 cubic yards of material, most of it rock. The present indications are that the tunnels will have to wait upon the completion of the station. The electrification of the Long Island Railroad has proved to be a thorough success, and the turbo-generators in the large power station at Thirty-fourth Street are giving complete satisfaction. In this connection, it should be noted that there is a steady displacement of the reciprocating engine by the steam turbine, particularly in the plants of large power stations, the Parsons and the Curtis turbines appearing to have practically exclusive control of the field in this country. It is to the electric roads that we are indebted for the introduction and rapid growth in favor of the all-steel passenger car. One of the leading railroads has adopted this type, not only for suburban, but for the long-distance and even the Pullman service. There is noticeable a decided growth of sentiment in favor of the use of the alternating current in preference to the direct in electrical traction, and particularly for long-distance service. A notable instance of this is in the equipment of the New Haven lines, which will use the alternating current from Stamford to Woodlawn, and the direct current of the New York Central from Woodlawn to Forty-second Street. The most important of the later developments of the year was the recent announcement that a single-phase electric road is about to be built, connecting Baltimore and Washington. This will be a two-track system, on which the express service will be run at a speed of sixty miles an hour. Just now the most notable steam railroad lines under construction are those of the Tehuantepec Railroad, which must necessarily prove a formidable competitor to the Panama Canal, and the so-called Cape to Cairo Railroad. The former line is about completed, and the latter has made such good progress, that it has now been carried over 2,000 miles north of Cape Town, and some 1,500 miles south from Cairo. Early in the year the road should reach Lake Tanganyika, after which it will be necessary to construct only about 400 miles of road in order to afford a complete rail, river, and lake route from Cape Town to the Mediterranean Sea. In this connection mention should be made of the recent attempt to interest the investing public in the proposed 700-mile Zambesi-Johannesburg electrical power transmission line—a scheme which, in spite of the prominent names which have recently been associated with it in press dispatches, seems to border on the "wildcat." If it does not pay to transmit from Niagara Falls to New York, the question may pertinently be asked: How can the thing profitably be done over twice the distance through a barren and savage country?

ELECTRIC ILLUMINATION.

Never has greater interest been displayed in new methods of electric illumination than during the past year. If the promises which are held out by the inventors of metallic filament lamps are fulfilled we may soon witness the passing of the carbon filament bulb. Although the Nernst lamp, on which great hopes were based because it requires only half as much current as the carbon filament, has proved too costly, and the osmium lamp has been found wanting for the same reason and for the additional reason that its voltage of 47 is too low for ordinary circuits, the tantalum and tungsten lamps seem likely successors of the standard incandescent lamp. The tantalum consumes about as much energy as the osmium lamp, but its long filament renders its use possible on a 110-volt circuit and on circuits of even higher voltage. Its useful life of 400 to 600 hours and its maximum life of 1,000 hours and more compare favorably with those of the best electric incandescent lamps in use. The filament is very delicate but able to stand greater variations in voltage than the carbon filament. When broken the ends readily fuse, so that the tantalum lamp's usefulness, although impaired, is not utterly destroyed. The present low cost of construction (about 50 cents), coupled with its high voltage, give it a decided advantage over the osmium filament. Guelcher's iridium lamp is made only for low tensions (24 volts); it consumes, it is claimed, only 1 to 1.5 watts per candle power, and costs about 87 cents. What its life may be it is impossible to state, inasmuch as no figures have been published. It is open to many of the objections leveled at the osmium lamp. More promising is the tungsten lamp, which is now made by four European firms using as many different processes. The normal tungsten lamp of Just and Hanamann seems to give about 30 to 40 candles at 110 volts and consumes 1.1 watts per candle. Kuzel's tungsten lamp is said to show an efficiency of 1 to 1.25 watts per candle for 19 to 32-candle lamps, with a useful life of 1,000 hours, at the end of which the loss in candle power is said to be but 10 or 15 per cent. When broken the filament automatically welds together as in the tantalum lamp. The Osmium tungsten lamps have shown from 54.7 to 55.6 candles and from 1.026 to 1.047 watts per candle at 110 volts. Whether these new lamps will fulfill the hopes placed in them can of course be determined only by thorough tests under conditions approximating those of actual service. At present the metallic filament lamp is in its experimental stage. The necessity of using the tungsten lamp in the inverted vertical position may perhaps be regarded as a defect; yet quite recently the vertical incandescent gas mantle has invaded an extensive field hitherto monopolized by the electric light.

AERONAUTICS.

In the field of aeronautics the most important event of the year was the publication of the first authoritative statement by the Wright brothers, regarding their successful power-driven aeroplane flights, made in the fall of 1905, and its acceptance by the Aero Club of America. It will be remembered that the SCIENTIFIC AMERICAN wrote to each one of the purported witnesses of these flights, and received the most convincing evidence that they actually took place. The most brilliant flight of the series was achieved on October 5, when the Wrights covered a distance of 25 1/5 miles at a speed of over 38 miles an hour, the flight terminating only with the exhaustion of the fuel supply. When the history of mechanical flight comes to be written, this achievement will give these two young machinists the same position that Stephenson holds in regard to the locomotive, Fulton to the steamboat, and Edison to the electric light. At the recent Aero Club show, the Wright brothers exhibited a 30-horse-power aeroplane motor designed and built for their new and larger machine which, with one man aboard, they are confident of driving for a distance of 500 miles at an average speed of not less than 50 miles an hour. With mechanical aeroplane flight an accomplished fact, we may now look for a diversion of interest and effort from the dirigible balloon to the aeroplane proper. Its field of usefulness will be found chiefly in military service, where it will be invaluable for reconnoitering purposes and for the conveyance of swift dispatches. In all probability its chief development ultimately will be in the field of sport, where it should enjoy a popularity equal to that of the automobile. The investigators who have confined their attention to the balloon and the dirigible balloon or airship, have also met with very encouraging success. The machines have grown in size, power, speed, and controllability. The largest of these is the monster airship of Count von Zeppelin, 38 feet in diameter and 410 feet in length, which is credited with being able to lift three tons additional to its own weight. It is said to have held itself stationary against a 33 1-3-mile-an-hour wind. The motive

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the run was approximately 14,500, or 1,300 in excess of the contract, and the average speed was 17.43 knots. The heavy spray thrown up over the bows during this run froze upon the forecastle deck and the bridge, with the result that, when the ship returned to the harbor, she presented the extraordinary appearance shown in the accompanying engravings, for which we are indebted to the courtesy of the Boston Sunday Herald.

REVIEW OF THE YEAR 1906.

(*Continued from page 5.*)

power consists of two 85-horse-power motors driving four propellers, two on each side of the ship. Another new dirigible is the latest French airship "La Patrie," 33¼ feet in diameter by 196 feet long, and driven by a 70-horse-power motor, which is credited with a speed of 30 miles an hour. This airship was built by the Lebaudy brothers for the use of the French government on the same general lines as the "Lebaudy" airship. The most successful trip occurred on November 26, when the airship sailed for two hours and twelve minutes, and covered a distance of 57¾ miles. A trifle larger than the "Lebaudy" airship is the new machine of M. Henry Deutsch, known as the "Ville de Paris." It is 196.85 feet long, 35.43 feet in diameter, and is driven by a 70-horse-power Panhard motor. Although the dirigible airship has received the most attention, the European inventors have done some meritorious work with aeroplanes, and mention should be made of those of Bleriot and of Santos Dumont. The latter, which is built on the lines of the Wright brothers' machine, recently managed to rise above the ground for a brief flight of a few hundred feet. The balloonists have been exceedingly active during the year, and world-wide interest was aroused by the great international race for the Bennett cup, when sixteen balloons, representing seven different nations, started from Paris and met with varying fortune. Seven of the machines crossed the English Channel and landed in England, the greatest distance, 402 miles, being covered by the American contestant Lieut. Lahm, who landed near Whitby, in Yorkshire. This distance was exceeded later in the year by an independent trip, not in a contest, made by Mr. Leslie Bucknall, an English aeronaut, who, starting from London, landed at Vevay, on Lake Leman, after covering 472 miles, the trip being remarkable alike for the distance covered and the high speed. With a view to stimulating the development of the aeroplane, the London Daily Mail recently offered a prize of $50,000 to any one who will travel by aeroplane from London to Manchester in one day. This was followed by an offer of the London Daily Graphic of $5,000 to the inventor who should fly with one or more passengers between two given points not less than one mile apart. Other prizes offered in England bring the total up to about $70,000. In the United States the Aero Club of America has offered a $1,500 prize for a balloon race at the Jamestown Exposition.

AUTOMOBILES AND MOTOR BOATS.

That the automobile industry has settled down to certain fixed types, and that improvement is to be looked for, from now on, more particularly in details, is proved by the fact that in any review of the year's work it becomes increasingly difficult to find any novelties of a radical and far-reaching character. This was evident at the seventh annual show of the Automobile Club of America, in which it was evident that the makers had approximated so closely one type and standard of excellence that a visitor failed to observe those broad points of difference between the machines which formerly lent a stirring interest to the technical review of these annual shows. The gasoline motor still reigns supreme. While the makers of steam and electrical machines are turning out a product of the highest excellence, these types give no signs of ever again becoming serious competitors of the automobiles driven by internal-combustion engines. The electric motor promises to find its most successful field of work in the propulsion of heavy motor trucks and delivery wagons, of which some splendid specimens were shown at the late exhibition.

The public interest in competitions both of speed and endurance remains unabated. At the Ormonde-Daytona meet, held early in the year, new world's records were made in almost every event. The most sensational feat was that of the Stanley steam racer, which covered the mile on the smooth sands of the beach in 28 1-5 seconds at a speed of 127.65 miles an hour. The 200-horse-power Darracq racer won the 2-mile race, covering the distance in 58 4-5 seconds at a speed of 122.46 miles an hour, which is the fastest speed ever made by a gasoline automobile. The 100-horse-power Napier racer secured the 100-mile record of 1 hour, 15 minutes, 40 2-5 seconds, at a rate of speed of 79.28 miles an hour. Later in the year occurred the Automobile Club of America's 2-gallon fuel efficiency contest, which was won by a four-cylinder, air-cooled Franklin runabout, which covered a distance of 87 miles at a fuel expense of 0.613 cent per ton-mile. The 24-horse-power air-cooled Frayer-Miller car covered 47.9 miles at the phenomenally low cost for fuel of 0.517 cent per ton mile. Toward the close of the year the annual Vanderbilt cup contest was run off with its usual brilliant success, although, as usual, the honors went to the foreign machines. The race was won by a 100-horse-power Darracq, driven by Wagner, who covered the 297.1 miles of the course at an average speed of 61.43 miles an hour, the second place being taken by a 120-horse-power Fiat driven by Lancia, whose average speed was 60.84 miles an hour. The failure of the American cars was attributed almost entirely to the failure of the non-skid tires with which all the contestants had to be equipped, because of the rather greasy condition of the track. The best of the American machines, notably the Locomobile and the Thomas, seemed to have plenty of speed; but they were so severely handicapped with tire troubles as to have no chance at taking a leading place. That they possessed the speed is evidenced by the fact that the fastest round of the course made by any contestant was credited to the 110-horse-power Locomobile, which covered the distance in 26 minutes and 21 seconds. That these races exert a beneficial effect upon the interests of automobiling in more ways than one is shown by the fact that as the result of the last Vanderbilt cup contest a 60-mile special automobile highway, on which the future contests will be held, is being built on Long Island for the exclusive use of automobiles. Other highways of the same kind are proposed, and it may prove that this venture marks the first of a system of such roads, which may ultimately cover the country.

It begins to look as though the application of the internal combustion motor to boat and ship propulsion will, in the future, find its most successful field not in flimsy high-speed racing craft, but in staunch, serviceable, sea-going launches and cruisers, and ultimately in the propulsion of various types of merchant craft. The record for racing craft still remains at the speed of 30¾ miles an hour at which it was placed by the French motor boat "Antoinette" in the year 1905. An interesting development of the racing craft is that of the hydroplane type, several of which have been illustrated from time to time in the columns of the Scientific American. In this type an effort is made to lift the boat clear, or partially clear, of the water and drive it along on a series of slightly inclined planes. A vessel of this type was recently tried on western waters, and two others in France, the latest type being that of Levavasseur, which consists of a front boat holding the motor, to which is attached a light wooden frame for carrying a long tail at the rear end of which is the propeller. The gasoline motor has been applied successfully to a torpedo boat by the Messrs. Yarrow in London, who produced a little vessel weighing only 8 tons which has shown a maximum speed of 26 knots an hour and has a radius of action, when carrying one ton of oil, of about 300 miles. This vessel has been purchased by the British Admiralty, and is likely to become the pioneer of a new and very useful type of torpedo craft. The producer-gas engine, also, is making progress in its application to the propulsion of vessels. The Thornycroft Company have recently constructed a vessel which is driven by a producer-gas engine of 500 horse-power, while the Otto Gas Engine Company have already fitted their producer-gas engines to a dozen or more vessels, the power ranging from 35 to 90 horse-power. The latest success of this company was realized with a flat-bottomed barge of 240 tons, which is driven by a four-cylinder, 100-horse-power engine. The vessel has proved to be highly economical in operation, as will be seen by the fact that during a single year 5,200 tons of freight were carried, representing nearly 2,000,000 ton-miles at a cost of about one-fourth of a cent per ton.

MERCHANT MARINE.

The most significant event of the year in the merchant marine has been the steady advance in the performance and popularity of the steam turbine, as a drive for ships of all types, sizes and speeds. It is true that in proportion to the number of ships afloat or even of those building, the number of turbine-driven vessels is, as yet, very small; but the uniformly excellent results obtained with the latest and most improved forms of marine turbines point with increasing emphasis to this as the ultimate type of engine for all vessels, unless we except the tramp steamers of large capacity and low speed. The year has witnessed the launch of the two Cunarders, the weight of each vessel as she went down the ways being over 16,000 tons. These ships, 786 feet long, 88 feet broad, 60 feet deep, and of 45,000 tons displacement, are considerably the largest afloat. Their contract speed is 25¼ knots on trial; their contract horse-power 68,000. The "Lusitania" will make her maiden voyage to this port in the summer and the "Mauretania" in the late autumn of 1907. Outside of these vessels and a sister ship to the "Kaiser Wilhelm II." being built for the North German Lloyd Company, all of the new transatlantic liners, now under construction, belong to the large, moderate-speed, freight-and-passenger type, represented by the "Kaiserin Auguste Victoria," of the Hamburg-American Line, which made her maiden voyage to this port during the year, and the new "Adriatic," of the White Star Line. A vessel which excited considerable comment on her appearance at this port, was the great auxiliary clipper "R. C. Rickmers," which has the distinction of being the largest sailing ship afloat, her length being 441 feet, and her displacement 11,360 tons. She is equipped with an auxiliary steam engine of 750 in icated horse-power. Under steam she can make from 6 to 8 knots an hour, and under sail she has made 16 knots. Shipping interests in the United States are in a bad way, at least as far as the deep-sea carrying trade is concerned. Shipbuilding on the Great Lakes is, as usual, in a wonderfully prosperous condition; and for the coastwise trade, several excellent vessels, some of them turbine-driven, have been built or are under contract. The only salvation of our deep-sea shipping will be the passage of the Shipping Bill, of which, thanks to the assistance of the President, there seems to be at last some real grounds for hope.

Meeting of the American Association for the Advancement of Science.

The Fifty-seventh Meeting of the American Association for the Advancement of Science was opened at Columbia University with a very large attendance at 10 A. M. on Thursday, December 27, by the retiring president, Dr. C. M. Woodward, who introduced to the Association the new president, Dr. W. H. Welch. An address of welcome was made by Dr. Nicholas Murray Butler, president of Columbia University, which Dr. Welch followed with a reply. At the adjournment of the general session, the various sections met at their respective meeting places. Interesting papers were read in the departments of Mathematics and Astronomy, Physics, Chemistry, Mechanical Science and Engineering, Geology and Geography, Zoology, Botany, Anthropology, Social and Economic Science, and Physiology and Experimental Medicine.

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The Current Supplement.

The current Supplement, No. 1618, opens with a handsomely illustrated article on "The Treasures of Cumæ." Dr. Wilhelm Haacke writes a popularly worded article on Mendel's law of heredity, which law taken in conjunction with the work of De Vries may be said to have partially upset the Darwinian view of heredity. Another biological article of rare interest is that by Prof. E. Korschelt, on Regeneration and Transplantation in Animals. Mr. John D. Shoemaker contributes an entertaining account of electricity in the treatment of disease. President Roosevelt's message on the Panama Canal is concluded. Among the minor articles may be mentioned those entitled Heating of Feed Water to Approximately Steam Temperature, Colors for Book Edges, the De la Vaulx Airship, and a Wick Carbureter. Those interested in home experimental science will find Mr. A. Frederick Collins's article on an easily made high-frequency apparatus well worth reading. Mr. Collins removes the general impression that currents of high frequency and high potential can be obtained only with apparatus of special construction and shows how either D'Arsonval or Oudin currents can be produced by a high-frequency apparatus which can be easily made at home and which consists of a plunge battery of six cells, an induction coil giving a two-inch spark, a pair of one-pint Leyden jars and an inductance coil. By far the most important paper which was read at the recent meeting of the American Society of Mechanical Engineers was that of Mr. Fred W. Taylor on the Art of Cutting Metals. An abstract of this paper is published. Mr. Taylor's work is probably the only treatise to be found in print on modern work with tool steel.

Since 1891, the electrolytic copper refining industry has undergone enormous expansion, chiefly in America, and the number of electrolytic refineries in existence in 1905 was stated to be thirty-two, distributed as follows: United States, nine; Germany, nine; United Kingdom, six; France, four; Russia, two; Austria-Hungary, two. To this total of thirty-two must be added four refineries, which are reported to be working in Japan.