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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 1901.

Compared with the brilliant array of scientific achievements which marked the last decade of the nineteenth century, it must be admitted that the opening year of the twentieth century has been strangely barren; so barren indeed that one might almost believe that the inventive mind was resting from its strenuous labors and superb achievements of the previous decade. In the closing days of the year, however, the world has been again startled by one of those epoch-making events which suddenly burst upon the world with not even a hint of their approach. We refer, of course, to the feat of the young Anglo-Italian Marconi in communicating by his wireless system of telegraphy across 2,000 miles of the Atlantic Ocean. So extraordinary is the achievement that, had it been claimed by any other man than Marconi, doubts might well have been expressed; but the invariable modesty and unusual conservatism of the inventor have satisfied the world at large that no such announcement would have been made by Marconi had he not possessed the most undoubted proofs of his success. It is true that the range of wireless telegraphy had been steadily increasing, but there was no such rate of increase as to prepare our minds for a jump from 200 or 300 miles to 2,000 or 3,000. With such an achievement on record, it is likely that the future historian will speak of the year 1901 as a brilliant opening of a brilliant century.

EXPOSITIONS.

The year has seen the successful carrying through of two excellent expositions, one at Glasgow and the other our own Pan-American at Buffalo. The former, as was natural in such a great center of mechanical industries as Glasgow, was distinguished by the excellent quality of the exhibits in the departments devoted to machinery and transportation. Although it was not comparable in point of size to some recent expositions, the quality of the exhibits seems to have been eminently first-class, and, judged from a standpoint of finance, it appears to have been a very thorough success. The more elaborate and important Pan-American Exposition at Buffalo closed on November 2, after having achieved its object of promoting the commercial interests of this country by advancing the friendly relations and commercial intercourse between the United States and other countries of the two Americas. The total admissions for the first six months were close to eight millions; but owing to the destructive snowstorm of last April and the ever-to-be-lamented death of President McKinley, there will be a financial loss of about $3,000,000. The government's exhibit, which was remarkably fine, has been shipped to the Exposition at Charleston.

CIVIL ENGINEERING.

Although the last year has not seen the completion of any notable civil engineering works, steady progress has been made upon many great undertakings that had been commenced in earlier years.

The Croton Dam and Jerome Park Reservoirs have been pushed forward; but the date of completion of these important works has been postponed by a proposed reconstruction, which will probably have to be carried out to render them perfectly stable. The 600 feet of core-wall-and-earth dam at the southern end of the Croton Dam will, in all probability, be replaced by a solid masonry structure, constructed on the same section as the masonry portion of the structure that is already completed. The change will involve an increased expenditure of several hundred thousand dollars, and will postpone the completion of the dam, probably until the early summer of 1904. The Wachusett Dam for the Boston water supply has been advanced considerably during the year.

Another great hydraulic work is that which is being carried out at New Orleans for the cleansing and draining of the great southern city. It was started in 1894 as a drainage system at an estimated cost of $8,000,000; but the city, under the spur of yellow fever epidemics, increased the issue of bonds by $12,500,000, in order to complete the drainage and install a complete sewerage system. The value of this work in its effect on the health and comfort of that city will be immeasurable. The stupendous irrigation works on the Nile have been carried along with increased energy. The object of the two great dams, one at Assouan and the other at Assiut, is to store the flood waters of the Nile and use them for irrigating and reclaiming a considerable area of the Nile Valley which is capable of great fertility under cultivation. An idea of the magnitude of the task can be gathered from the fact that the river at Assouan is over a mile in width. Twenty-five thousand natives have been engaged steadily on the work in day and night shifts. The undertaking will cost $25,000,000, and will add 2,500 square miles to the crop-bearing area of Egypt, the value of which to the country is estimated at four hundred million dollars. Of that great engineering work, the Siberian Railroad, we have heard but little during the year, but the indications are that by 1903 this great artery of travel will be completed.

The construction of the new East River Bridge, of 1,600 feet span, which has advanced very slowly during the past twelve months, is taking on new life; and it is to be hoped that under the new administration, this greatly needed work will be pushed to a rapid completion. At present the Roebling Company are only just starting on the construction of the great cables. A few of the strands have been completed, but practically the whole of the suspended structure has yet to be built, to say nothing of the long approaches in Manhattan and Long Island. Work has just commenced on the caissons for the new 1,500-foot suspension bridge which is to be built in close proximity to the present Brooklyn Bridge; but this means of communication cannot be reckoned upon for some five or six years to come. The preliminary engineering is being done on the new cantilever bridge which is to cross the East River at Blackwell's Island. As a result of the determination of the Pennsylvania Railroad Company to reach Manhattan by tunnel, it would seem as though the construction of the Hudson River Bridge has been postponed indefinitely.

Other important engineering works during the year were the dredging of the 40-foot entrance channels to New York city (the 40-foot channels will be 1,800 to 2,000 feet in width and of a uniform depth of 40 feet), the completion of the Riverside Viaduct, and the opening of t e Willis Avenue Bridge across the Harlem. The Riverside Viaduct, 2,074 feet in length and 60 feet in width, is a steel structure which will form an important link in the magnificent system of driveways stretching from Seventy-first Street along the banks of the Hudson River to the northern extremity of Manhattan Island, while the Willis Avenue Bridge serves to carry the Third Avenue thoroughfare across the Harlem River. The driving of the great Simplon Tunnel through the Alps has been proceeding apace; about half of the work has been done, and the indications are that the tunnel will be opened within the contract time, or during the year 1903.

An important preliminary step toward the execution of what will be one of the greatest civil engineering works of the world was the presentation of the full report of the Isthmian Canal Commission. It will be remembered that the preliminary report, made last year, set down the cost of the Nicaragua Canal at $200,000,000. The final estimate of the cost reduces this amount to $189,864,000. It is estimated that to complete the Panama Canal, with the same section and capacity of locks, etc., as Nicaragua, would cost $144,233,000. The Commission's report, judged from the standpoint of engineering and subsequent operation, is favorable to Panama; but as the latter is saddled with a demand from the owners of the Panama property of $109,141,000, the report advocates the construction of the Nicaragua Canal. For the failure of the Panama people to get a recommendation from the Commission that their canal be chosen, they have themselves to thank. As we go to press the news comes from Paris to the effect that at a recent meeting of the shareholders, they expressed a desire to sell out to the United States for whatever it considered to be a reasonable sum. If the Panama Company were willing to take for their property the $40,000,000 difference between the cost of completing the Panama and building the Nicaragua Canal, Congress would probably be disposed to take up the Panama scheme, because of its superior location and shorter length. A canal that is 46 miles long and takes twelve hours to navigate, and whose curves are few and easy, is, on the face of it, a better proposition than a canal 183 miles long which will take thirty-three hours to navigate, that is full of sharp curvature, and that will be at all times because of this curvature troublesome to navigate. These are simple engineering facts which cannot fail to govern the situation should a reasonable offer of the Panama property be made.

AUTOMOBILES.

The year 1901 will always be famous in the annals of automobilism, both on account of the mechanical developments of the automobile and the extraordinary speed records which have been made. The most remarkable records were those achieved in the Paris-Bordeaux race, when the winner covered the distance, exclusive of slow-downs, in passing through cities, at the rate of 53½ miles an hour. This performance was followed by the Paris-Berlin race, in which the distance, 744 miles, was covered by the winner in the net time of sixteen hours and six minutes, at an average speed of about 47 miles an hour. In this country Mr. Winton, driving a 40 horse power machine, covered a mile on the track in 1 minute 6 2-5 seconds, while on a mile straight away in the races held on the Coney Island Boulevard late in the year the world's record for speed was broken by several contestants, Fournier on his 40 horse power Mors racer winning the mile in 51 4-5 seconds; Foxhall P. Keene on a similar machine making the distance in 54 seconds, A. C. Bostwick on a 40 horse power Winton gasoline carriage making it in 56 2-5 seconds, and A. L. Riker covering the distance in 1 minute 3 seconds on an electric racing automobile. Mechanically, the automobile may be said to be exercising a most stimulating effect in the production of motors of great power in proportion to their weight, and every possible kind of fuel has been employed. The SCIENTIFIC AMERICAN has illustrated several of the most successful of those types. Among these we may mention a kerosene motor in which the oil is sprayed as directly as possible into the cylinder, a type which, we understand, has given very satisfactory results. The French manufacturers, who have lost none of their activity, and whose work continues to be marked by the signal success with which it has been always attended, have been experimenting with alcohol and are using it in two types of motors; one in which pure alcohol is used, the other in which it is mixed with 50 per cent of gasoline, the latter being the most common practice. In both this type and the kerosene motor, carbureters are used which are similar to those used in the ordinary gasoline motors. The French have also produced an automobile which is driven by ether, which is utilized in the same way as naphtha in a naphtha launch, the ether being boiled in a closed vessel and the resulting vapor expanded in the motor, condensed, and pumped back to the boiler. Another interesting motor is one which makes use of compressed air, the air being compressed by a kerosene oil engine carried on the carriage, and superheated by being circulated within the cylinder jacket. Theoretically this motor should show excellent economy, since the compressed air being used before it cools off, the heat of compression is not lost, and the air in circulating around the oil engine cylinders takes up much of the heat of combustion and transforms it into useful work at the axle. The progress of the industry in this country, as shown at the recent Automobile Exhibition in this city, was extremely gratifying; the form and finish of the American-made machines compared favorably with the very best work of the old, established European makers.

AERONAUTICS.

Of late years the efforts of experimentalists in the field of aeronautics have been directed rather to the airship than to the aeroplane. Indeed, the whole history of this fascinating science has been marked by a pendulum-like swing between the aeroplane and the navigable balloon. Maxim, Lillienthal and Langley are not heard from so much as De la Vaulx and Santos-Dumont. De la Vaulx has been working for a number of years on the problem of steering balloons upon the sea and during the past year he made an ambitious attempt to cross the Mediterranean in a balloon escorted by the cruiser "Du Challia." Owing to boisterous weather, the attempt was a failure. Santos-Dumont's experiments, which have attracted world-wide attention, had for their objective point the winning of the Deutsch prize of $20,000, offered to the first aeronaut who should successfully make the trip from the Aero Park in the suburbs of Paris around the Eiffel Tower and back again in 30 minutes' time. This indefatigable young Brazilian, after several attempts, in one of which his balloon was completely wrecked, succeeded in winning the prize, with only a fraction of a minute to spare. The airship in which he made the trip is 98 feet in length, 15 feet in diameter and is driven by a gasoline engine of 20 horse power. The motor and propellers are carried on a trussed frame which is suspended below the balloon by means of steel wires. Although the most notable experiments are those that have been made by gas-supported airships, a large number of less widely advertised attempts have been made with machines of the aeroplane type. Among these may be mentioned Nemethy's flying machine, driven by a 2½ horse power gasoline motor; the Hoffman flying machine, driven by a steam motor; and the Whitehead flying machine, which is built after the model of the bat(

Contemporaneously with Santos-Dumont's experiments, there have been three other attempts which are worthy of mention; one a machine built by Henri Deutsch, modeled somewhat on the lines of the Dumont machine, and the others two English machines, one built by Mr. Buchanan and the other by Mr. Bastin. Both of these are of the aeroplane type. Although the successes of the year are of scientific interest, they have not yet brought us within sight of a commercially useful airship.

MERCHANT MARINE.

In reviewing the history of the merchant marine, it must be admitted that the ship of the year is the "Celtic" of the White Star Line, which has the distinction of being considerably the largest vessel ever constructed in this or any other age. Though not so long by four or five feet, she is seven feet broader than the "Oceanic," and has fuller lines. Her gross tonnage is 20,880 tons, as against 17,274 tons of the "Oceanic," and 18,915 tons of the "Great Eastern," while on a maximum draft of 36 feet 6 inches she will displace 37,700 tons, or 14,200 tons more than the "Deutschland." She is of the mixed cargo and passenger type of moderate speed, which is becoming increasingly popular. In addition to her vast cargo capacity, she has accommodations for 2,859 passengers and a crew of 335, making a total complement of 3,194 souls. Of high-speed passenger steamers there have been added two during the year, the "Kronprinz Wilhelm" of the North German Lloyd Company, and "La Savoie" of the Compagnie Générale Transatlantique. The first named, built at the Stettin yards, is an enlarged and more powerful "Kaiser Wilhelm," 663 feet 4 inches in length, 66 feet broad and 43 feet molded depth, and of 21,280 tons displacement. She carries the four funnels, so familiar in the German ships. On her maiden trip she covered the eastward passage in 5 days 9 hours and 48 minutes, the best day's run being 540 knots at a speed of 23.3 knots per hour.

"La Savoie" is the second of a pair of handsome new vessels that the French line have lately added to their service, the first being "La Lorraine." "La Savoie," 580 feet long, 60 feet broad by 39.6 feet deep, and of 15,300 tons displacement, made her first trip to this port at an average speed of 21½ knots an hour. The dimensions of "La Savoie" are not equal to those of the largest ships of other lines, for the reason that the port of Havre imposes rather restricted limits of draft and length. The Hamburg-American fier "Deutschland" has added somewhat to her prestige by raising her average speed for the eastward passage from 23.3 knots to 23.5 knots an hour, a record which she seems likely to hold, at least until the new North German Lloyd "Kaiser Wilhelm II." makes its appearance. Unfortunately, Congress did not favor the Ship Subsidy Bill for the promotion of the American merchant marine, by which it was sought to place our shipbuilders and shipowners on an equal basis with their foreign competitors in the keen competition for maritime supremacy. Hence the finest and fastest vessels will continue to be built by foreign firms, and the cream of our passenger and freight traffic will be carried in foreign bottoms. The most notable ship to be launched during the year in this country was the "Korea," a fine freight and passenger liner, which has the distinction of being the largest steamship ever built in America. She is 572 feet 4 inches long, by 63 feet broad, by 40 feet deep, has a displacement of 18,600 tons, and was designed for a speed of 18 knots an hour. The vessel was built by the Newport News Shipbuilding and Dry Dock Company for the trade between San Francisco and Hong Kong. The "Korea" was launched in March, and the sister ship "Siberia" a few months later. The most interesting vessel launched abroad this year was undoubtedly the turbine-propelled river passenger steamer "Edward VII." This is the first attempt to apply the steam turbine to passenger service, and the results have been very gratifying. The motive power consists of three turbines working on three shafts, a high pressure in the center and two low pressures, one on each outer propeller. It is claimed that the total expansion ratio is about 125-fold. The vessel has shown its ability to maintain 20½ knots an hour in daily service; and in addition to the larger passenger accommodation due to compactness of motive power, there is a total absence of vibration. There is a decided revival of interest in the sailing ship as such, particularly in this country, where the great success of the multi-masted schooner has led to the construction of craft of this type with six and even seven masts. There is now under construction a truly mammoth schooner which will be just under 400 feet in length, 50 feet in beam, with a molded depth of 34 feet 5 inches, a displacement of 10,000 tons, and a dead weight cargo capacity of 7,500 tons. Steam donkey engines are used for handling sails on these big craft, with the result that the crew is exceedingly small for the size of the vessel, the total number of men required for this schooner being only nineteen. The type has proved to be exceedingly economical; the largest of them carrying freight at a rate considerably less than that asked by tramp steamers.

RAILROADS.

Although the work of active construction on the Rapid Transit Subway in New York has not been under way for more than eighteen months, it has been prosecuted with such diligence that the close of the year finds the contractors fully seven months ahead of their contract time. Out of a total estimated earth excavation of 1,700,000 cubic yards, a little over half has been removed; while out of a total of 1,300,000 cubic yards of rock, about 400,000 cubic yards has been taken out. If we estimate the rate of construction by the sum paid for work done, we find that out of a total contract price of $35,000,000, about a third has been paid to the contractors. The indications are that this splendid system will be open for public use by Christmas, 1903. During the year the Rapid Transit Commission decided to extend the system from City Hall Park, the present terminus, to the Battery and beneath the East River to Borough Hall, Brooklyn, and the necessary surveys are now being made.

Of scarcely less importance to Greater New York than the Rapid Transit tunnel, is the remarkable scheme of the Pennsylvania Railroad Company for connecting the Pennsylvania system directly with the Long Island roads and with New York by a series of tunnels, which will extend from New Jersey beneath the Hudson River, Manhattan Island, and the East River to Long Island. The preliminary plan, as filed with the County Clerk, calls for two tunnels running side by side beneath the Hudson River and diverging as they approach the New York side, where they extend beneath 31st Street and 32d Street to a great central station which will occupy the greater part of the blocks included between Tenth and Seventh Avenues and 31st and 33d Streets. This station will be practically a three-deck structure, consisting of tracks and platforms 45 feet below the street, a broad overhead causeway, and a vast surface station and offices erected at street grade. From the central station three tunnels will extend below the East River and reach the surface at Thompson Avenue, a mile and a quarter back from the Long Island shore. The boldness and vast scope of this scheme are characteristic of the great railroad that is behind it. It will not only afford a direct suburban service with Long Island and ultimately with New Jersey, but it will permit passengers to travel directly without change of cars from New York to the Pacific Coast or any point in the United States or Canada. Should the scheme of the late Austin Corbin commend itself, there will be an opportunity to connect the Pennsylvania system with a steamship terminal at Montauk Point. Moreover, the tunnel will give the Pennsylvania system a direct railroad connection with the New Haven system by way of Long Island and a bridge at Port Morris, thus avoiding the delay and undoubted risk of the present railroad ferriage around the Battery and up the East River. Another important work affecting the transportation problem in New York city, which is approaching completion, is the electrifying of the Manhattan Elevated Railroads. The big 100,000 horse power power-house at Seventy-sixth Street has been completed and the first engine and alternator installed. The laying of the third rail and the electrical connections on Second Avenue are also completed, and trains should be running on this division within a few days. The power house is to contain the largest stationary engines and alternators ever constructed, the former being of 8,000 horse power, and each of the alternators being 42 feet in diameter by 10 feet in width, the revolving field being 32 feet in diameter and weighing 185 tons, while the total weight of the whole alternator complete is 445½ tons. With the completion of this work the capacity of the elevated roads will be greatly increased. Ten minutes will be taken off the total running time from the Battery to 145th Street, and an additional car will be included in each train during the rush hours.

MECHANICAL ENGINEERING.

While there has been no startling development in mechanical engineering during the year, there has been a steady, satisfactory progress. Much that might be said under this heading will be found included under "Railroads," "Automobiles" or "Aeronautics," for the reason that in the field of motive power unquestionably the most interesting development has been that of the internal combustion engine. The automobile and navigable balloon, by demanding a very low ratio of weight per horse power in motors, have proved an enormous stimulus to inventors in the development of prime movers. The steam turbine, of course, continues to be the most interesting of the steam engines, and of these the Parsons type continues to hold the first place in public interest, and in the achievement of practical results. The two 1,000-kilowatt turbine plants at Elberfeld, Germany, have shown a steam consumption of 11.9 pounds per indicated horse power per hour. At the same time, the extraordinary results obtained by the "Inch" Line of steamers marks a record in economy for the reciprocating engine. Two of these vessels, the "Inchkeith" and the "Inchdune," have made the trip from Newcastle to London on a consumption of coal which worked out respectively at 0.99 and 0.97 pound per horse power per hour. These results were obtained by making use of every refinement known in steam engineering practice. Four of the five cylinders are lined and steam-jacketed, and the expansion is quadruple in five cylinders. The boiler pressure is 261 pounds to the square inch. The steam is superheated to 469½ degrees, and the air is heated to 290 degrees before entering the furnaces. The feed water is raised to 209 deg. in a contact heater and to 370 deg. in a surface heater before entering the boilers. The question next to be solved is whether it would pay to install the costly equipment necessary to secure these results on high-speed passenger steamers, and whether equally good results could be secured with a 35,000 horse power equipment as with one of 5,000. If so, we may look for quite a marked increase in the speed of fast passenger ships without any corresponding increase in the cost of running them, for it is coal consumption that is the limiting feature of these vessels. In this connection it is a significant fact that the fastest steamship in the world, and the one with the largest indicated horse power, is equipped with a system of forced hot draft, and that the engineer of the ship attributes to this system the extraordinarily large horse power that has been secured and the excellent economy of fuel which accompanies it, the consumption being 1 1-3 pounds per horse power per hour. The waste heat auxiliary engine of 150 horse power at the Technical High School of Charlottenburg, Prussia, is giving excellent results, for as a net result the steam and waste heat engine together developed an additional energy equal to 34.2 per cent of that of the steam engine alone. Moreover, the steam consumption was reduced to 8.36 pounds per indicated horse power per hour: a most remarkable result, especially when the smallness of the unit is considered. As a result of these experiments, a cold vapor engine plant has been constructed and tested in daily service at the central station of the Berlin Electrical Works in Markgrafen Strasse. The average steam consumption had been 18.35 pounds per indicated horse power per hour. When the cold vapor engine of 175 horse power was put in operation, it was found that there was an addition of 41.7 per cent to the working energy of the compound steam engine from which it receives and utilizes the waste heat in the form of exhaust steam. It is claimed at the Technical School that this dioxide-vapor engine is yet in the infancy of its development and application; and certainly in view of the remarkable results obtained, we are justified in believing that the system will have a most extended application, particularly in large central stations.

In locomotive engineering there have been no developments involving the introduction of new principles. Compounding is more in vogue abroad than here, although a new type of tandem compound has been brought out for the Northern Pacific Railway, which has been so successful that twenty new engines have been ordered from the Schenectady company. The cylinders are 15 and 28 inches by 34 inches stroke; the high-pressure cylinder being placed forward of the low-pressure cylinder, both pistons being placed on a common piston rod. Most of the new types of engines that have been produced are of the simple type, and for express service there is a preference for the Atlantic type with trailing axle beneath the firebox. The new expresses for the New York Central are the most powerful express engines in existence. Their principal particulars are: Cylinders, 21 by 26 inches; drivers, 79 inches; weight, 176,000 pounds; total heating surface, 3,505 square feet; steam pressure, 200 pounds; tractive effort, 25,350 pounds. The Vanderbilt cylindrical firebox boiler continues to demonstrate its efficiency in hard service and is being quite extensively adopted.

ELECTRICAL.

Unquestionably the most important developments in the electrical world have been those connected with telegraphy and telephony. The announcement of the brilliant conclusion of the course of experiments carried out by Dr. Pupin, in his investigation of the long-distance telephone, which appeared in the SCIENTIFIC AMERICAN during 1900, was followed by the announcement early in 1901 that he had disposed of his patents to the American Telephone and Telegraph Company for the sum of $500,000. Dr. Pupin first formulated a mathematical theory of the propagation of electrical waves, and then constructed an experimental cable which verified the theory and opened the way for the construction of a cable suitable to commercial use. Dr. Pupin's first cable was 235 miles long; his second, 500 miles; and his third and most successful cable, 250 miles in length. The inductance coils have been used successfully on a Bell telephone air line of 700 miles in length, and Dr. Pupin considers that by the use of his system telephonic messages may be sent

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RETROSPECT OF THE YEAR 1901.

(Continued from page 3.)

over a 3,000-mile cable. The year has served to bring prominently into notice and see firmly established the Burry and Murray telephone systems, both of which are of the page-printing type. The Murray system has been adopted by the Postal Telegraph Company, and it has achieved a speed of as many as 130 words per minute. The Burry system is particularly adapted to city work, for the distribution of news from a central to a large number of outlying offices. During the year the contract was placed for the construction of the Trans-Pacific Telegraph cable, connecting Australia direct with England, via Canada. The cable will run from England to Vancouver, thence to Queensland and New Zealand by Fanning Island, Fiji and Norfolk Island. Its total cost will be just under $10,000,000, and it is to be completed by 1902. In the telegraphic world the most worthy events have been those connected with the development of the Marconi system of wireless telegraphy, which has been successfully applied to warships and to the vessels of the merchant marine. Incoming ships have been reported off Nantucket, and put in communication with New York several hours before their voyage was completed, while passing ships of the Cunard Line have picked each other up in mid-ocean and have communicated until they were as much as 190 miles apart. In the closing days of the year Marconi succeeded in sending wireless telegraph messages from the coast of Cornwall to Newfoundland, over 2,000 miles of ocean. He arranged that the letter *S* should be repeated at stated intervals, and he has announced to the world that the letter was heard by means of a delicate telephone receiver at the prearranged intervals of time, and at the hours predetermined upon. In electrical traction the most interesting work has been connected with the development of the Ganz system, in which current of the high potential of 3,000 volts is employed directly to the motors. The most important installation is that of the Meridionel Railway Company in Northern Italy, on which this new system is employed. The experiments on one of the German government roads in high-speed electrical traction, in which three-phase system high-potential current is used direct at the motors, has had some successful preliminary trials, in which a speed of just slightly under 100 miles an hour has been achieved.

NAVAL AND MILITARY.

We have so recently described our progress in naval matters in the Special Edition of the SCIENTIFIC AMERICAN that it is not necessary to do more than refer the reader to our issue of December 14, on the Development of our Navy since the War with Spain. The most noted military success of the year was the complete destruction of a 12-inch Krupp plate by 12-inch high explosive shells. So effective were the filler and the fuse that 20 pounds of government high explosive was carried into the plate and burst as it was passing through, with the result that the plate was smashed to fragments. The Gathmann torpedo-shell, containing 500 pounds of guncotton, fired at a similar plate, failed to produce results that were in any way comparable.

BREAD-MAKING BY MACHINERY.

Although the art of making bread dates back to the most remote period of civilization, only within the last fifty years have its scientific aspects been systematically studied. With the classic labors of Liebig in the chemistry of fermentation, bread-making was radically changed. The baking of a loaf was no longer a matter of individual skill, but of scientific knowledge. By reason of this change of method the little cellar-bakery, in which bread of poor quality was only too often made, began to give place to the modern factory-bakery equipped with elaborate machinery and with ovens of improved construction. The result has been that bread has been vastly improved in quality and is now made in accordance with certain well-established chemical rules. To illustrate the methods which are followed in a well-equipped modern bread-factory, the present article is devoted to a description of the Fleischmann Vienna Model Bakery, which supplies New York with a large portion of its bread.

The raw material employed in the making of bread at the bakery in question consists principally of flour, yeast, milk, and water. For the finer varieties of bread, butter is used. The flour is piled in sacks to the number of six thousand in a large storeroom occupying the topmost floor of the factory building, and is composed of spring wheat, winter wheat, and pure rye. Although modern milling machinery has done much to improve the quality and cleanliness of flour before it reaches the consumer, the baker finds that it must be still further cleaned before it becomes fit for his purpose. Consequently an elaborate cleaning apparatus or "dresser" is employed, invented by the late Jonathan Mills, which so thoroughly refines the flour that even the finest fibers of the sack are removed in passing through the machine. The cleaning apparatus comprises essentially a system of hoppers, screens, conveyers, and bins.

The hoppers are located at one end of the flour-storage room; and into their mouths the flour is poured. At the lower tapered end of each hopper an adjustable rocking closure is suspended by rods, which closure permits the passage of a definite amount of material. As the rods swing from side to side the closure rocks and permits the flour to drop into a spiral conveyer, by which it is transferred into a rotary screen. As the flour is whirled around and mixed in this rapidly-turning screen, it is driven by its centrifugal force toward one end of the screen; but before it reaches that end it has sifted through the meshes. The foreign matter and impurities are left behind, and these alone emerge from the end of the screen, left open for that purpose. The sifted, cleaned flour is transferred by a screw-conveyer, mounted immediately below the rotary screen, to a bucket-elevator, by which it is raised to the flour-storage room and conveyed to four bins by way of separate chutes. As the one bin receives its charge, its chute is closed, so that the next bin may be filled. This cleaning apparatus is constantly in operation; for during a working-day some 200 barrels of flour must be refined.

The four bins in the storage-room are situated directly above four dough-mixing machines on the floor below. And to each mixing machine the flour is carried by a small screw-conveyer and a flexible pipe-like chute from the superposed bin. Above each machine is a tank in which cold and hot water are mixed until a temperature varying from 90 deg. in summer to 95 deg. in winter is attained. Into each mixing-machine 60 gallons of milk and water, previously mixed by a baker, 840 pounds of flour, 15 pounds of salt, and a suitable amount of yeast, are introduced to form what is technically called a "sponge." In the making of rye bread caraway seed is also mingled with the other material. For the finest varieties of bread, milk and butter are used, as we have already remarked.

Although the four mixing-machines differ somewhat in detail, the main elements of the construction are the same in all. Each machine comprises essentially an iron vessel mounted to swing, in which a double spiral dasher or mixer is mounted, and is turned through the medium of gearing driven by a belt and pulley from a countershaft. When the mixing-machine has received its charge of material, the belt is shifted from a loose to a fast pulley, whereupon the dashers turn and knead the sponge into dough. Human hands could never knead so thoroughly and so quickly. After twenty minutes of mixing and kneading, by which the ingredients are intimately commingled into a perfectly homogeneous mass, the mixing machine is swung downwardly on its axis, and from the turning dasher the dough is cut with a long-bladed knife and collected in a wheeled trough.

Time was when this kneading and mixing was done by hand. The workmen washed their hands and cleaned their nails before kneading and handling the dough. But it is hard to knead dough thoroughly by hand; and perspiration must break out from the pores with the arduous labor. By using mechanical kneaders the dough can be mixed, thoroughly kneaded, without touching it with the hands. How great is the saving in time and labor wrought by these machines may be conceived when it is considered that the work which each performs in twenty minutes required at one time the incessant labor of two men for three-quarters of an hour.

Before machinery was introduced in the making of bread a man worked from twelve to thirteen hours a day in a large bakery and from seventeen to eighteen hours in a small bakery. At present all large bakeries, at least those of New York city, employ their men only during sixty hours per week.

The dough collected from the mixing machines in the troughs is now allowed to ferment or "raise," as it is popularly called, a process which requires about two and a half hours. After fermentation the dough is ready to be molded by hand into loaves of some forty different shapes and sizes. Adequate machines for this purpose have never been devised.

From the mixing-room the fermented dough is dropped into a molding and oven room by chutes, the rye-bread dough passing down by one way, the wheat-bread dough by another. The rye-bread dough is carried to a table in the mixing-room, cut into pieces of a certain weight, dropped into a machine called a "break," and then passed down into the molding and baking room by way of a chute to be molded and baked. The "break" consists merely of a pair of rollers placed side by side, and serves the purpose of squeezing the air out of the dough.

The wheat-bread dough, on the other hand, is subjected to no squeezing, but is conveyed directly by a chute to a table, to be cut up and distributed among the men who are to work it into its proper shape. After having been molded into loaves the dough is allowed to raise in a steam-box for one-half an hour.

In the walls of the baking-room fifteen ovens are built into which the loaves are inserted by long-handled wooden shovels commonly called "peels." The baking extends over a period of one-half to three-quarters of an hour, depending upon the size of the loaf. The interior of the ovens is lit by gas to that the loaves can be readily seen. Of the various ovens employed, a large double Werner-Pfleiderer drawplate oven should be particularly mentioned; for it constitutes a most valuable adjunct to the baking plant.

The oven in question has two heating chambers arranged in as many tiers, and two carriages, each of which receives a baking plate and is run forward and back in its chamber. Hangers of different lengths extend from the forward ends of the carriages and are curved in the lower carriage so as not to impede the upper. These arms or hangers run on rails to guide the carriage into the oven. The construction utilizes the space in front of the oven to the best advantage; for large-sized baking plates may be drawn out to their full length.

After the baking the loaves are collected, classified, as it were, and taken to the shipping room. Here they are loaded on some fifty delivery wagons and distributed throughout the city of New York.

The output of this model bakery aggregates about 43,000 loaves of bread and 15,000 rolls per day.

Correspondence.

A Universal Language Again.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of December 21 Mr. George Wilson very decidedly affirms that "There can never be a universal language." He supports this contention by a number of statements that call for some comment. I quite agree with his first paragraph, in which he denounces the idea of reviving Latin, as a universal language; we have to-day an international language—the English—which is spoken by probably 140,000,000 of people, and the use of which is rapidly spreading. The idea of reviving a dead language, the pronunciation of which is almost unknown, and abolishing the leading language of civilization, seems absurd. But, so far as Mr. Wilson's other reasons against a universal language are concerned, I beg to object. Unless I am utterly at sea, there is no such difference in the human vocal organs as he imagines. If there were, would it not be impossible for Englishmen to learn French, or the reverse? But I have just been taking a course of pronunciation in French, and my Parisian teacher tells me that my sole difficulty lies, not in the need of the proper organs, but in my misuse of them; and he assures me that with a little practice I shall be able to speak French as well as himself. Mr. Wilson may deny this, but there are other facts. Our Canadian Premier, Mr. Laurier, speaks English and French equally well. How could this be if his vocal organs were only fitted to speak French? But a few weeks ago, Mr. Wu Ting-fang, the Chinese representative in the United States, was a frequent speaker at a variety of meetings, and, if one thing was more patent than another, it was that Mr. Wu could speak English not only with good taste and expression, but so as to be understood by the audiences better than most of the English-speaking orators. If there were any such differences in the vocal organs, we might expect them to be exhibited in negroes more acutely than in any other persons; but it is patent that educated negroes—apart from a certain thickness sometimes arising from thick lips, and sometimes also perceptible in white people—can speak English as well as whites.

The idea that climatic differences make such a change in the use of the vocal organs as to revolutionize a language is belied by common experience. A well-educated man or woman from England, Ireland or Scotland can only be distinguished from similar persons in Canada or the United States by their generally clearer and more definite pronunciation; and it is evident that variation in vowel sounds arises from other than climatic causes. If Mr. Wilson's contention holds good, all vowel sounds involving the wide opening of the mouth would have been discarded in high latitudes. I have traveled from Halifax, N. S., to Victoria, B. C., and have addressed audiences at many cities and towns between those far-distant places; and, while I was never able to detect anything more than the ordinary personal variations, I never had the slightest difficulty in making myself understood.

Whether a universal language be possible or desirable, I think most people will agree with me, that a language which possesses the immense literature now printed in the English tongue, which is spoken by more people than any other western language, and which is making immense and rapid strides in all quarters of the globe, bids fair to become such a language, if any one does. It might have local dialects, such as every language possesses and always has possessed; but this fact would not prevent the written and printed language being uniform, as is practically the case to-day all over the civilized world.

Toronto, December 21, 1901. J. SPENCER ELLIS.