Scientific American.

ESTABLISHED 1845

MUNN & CO., - - - EDITORS AND PROPRIETORS.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, - - NEW YORK.

TERMS TO SUBSCRIBERS

One copy, one year, for the United States, Canada, or Mexico $3.00
One copy, one year, to any foreign country, postage prepaid. £0 los. 5d. 4.00

THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (Established 1845).....$3.00 a year.
Scientific American Supplement (Established 1876) ..... 5.00 "
Scientific American Building Edition (Established 1885). ..... 2.50 "
Scientific American Export Edition (Established 1878) ..... 5.00 "

The combined subscription rates and rates to foreign countries will be furnished upon application.
Remit by postal or express money order, or by bank draft or check.
MUNN & CO., 361 Broadway, corner Franklin Street, New York.

NEW YORK, SATURDAY, MARCH 23, 1901.

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.

AMERICAN ENGINEERING PROGRESS.

During the spring of last year there appeared in The London Times a series of fourteen articles on the subject of American engineering competition, written by a special correspondent of that journal, who had made a tour of the principal industrial centers of the United States for the express purpose of comparing American industrial methods with those in vogue in Great Britain. This remarkable series, which was republished in consecutive numbers of the SCIENTIFIC AMERICAN SUPPLEMENT, commencing July 21, 1900, was evidently the work of a thoroughly qualified observer. It created a profound impression upon British manufacturers, the most advanced of whom were already familiar with the broad aspects of a question, which was here more explicitly discussed. The influence of these articles upon the British press, however, was to arouse a considerable amount of heated and antagonistic discussion, the consensus of opinion being that the articles were altogether too pessimistic in regard to the future prospects of British trade.

The author of the articles has recently commenced a second series, under the title, "American Engineering Progress," in which he undertakes to prove that his prediction of last year is already being fulfilled. The writer had predicted that the natural resources of the United States, the energy with which these resources had been developed, the splendid equipment of American steel works and the large scale upon which they were operated, would prove a menace to the British steel industry, whenever the slackening of the home demand in this country should leave a surplus product available for exportation. In the first article of this series, which will be found in full in the current issue of the SUPPLEMENT, The Times' correspondent states that there seems now to be dawning the period foretold, inasmuch as American makers are not only sending their surplus product to markets that are common both to themselves and Great Britain, but also are carrying the invasion into Great Britain itself. He quotes a Glasgow correspondent who, writing in November of last year, stated that steel rails continued to be very much depressed, since most of the export orders were being absorbed by American mills, at prices which British manufacturers could not at that time touch. At the same period, another correspondent, writing from Middlesbrough, stated that German manufacturers were offering plates at a price with which it was impossible for the home manufacturer to compete.

While it is admitted that the British steel makers are aware of the threatened attack upon their natural market, and that they are doubtless taking steps to meet the invasion, there is a strong disposition, chiefly on the part of the press, to look upon the matter simply as a spurt due to a temporary disturbance of the balance of trade, while there is a prevalent opinion in England that no country heavily protectionist in its settled policy can compete with free-trade in Great Britain. The writer admits that there is much to be said both for and against the latter view, but at the same time urges that no effort should be spared by Great Britain to develop her resources to the utmost and bring her blast furnaces and steel-making trades to the highest pitch of excellence reached in the United States, Germany, or elsewhere.

The Times' correspondent goes to the root of the matter when he says that a favorite method of avoiding the unpleasant admission that a very real crisis is at hand, is to point to the fact that the cry of calamity has been heard in England for the past three hundred years, one commentator on the articles on American engineering competition going back to the reign of Queen Elizabeth for a quotation to prove his point. In reply to these statements, it is pointed out that during the nineteenth century the development of the factory system, which in turn has been the result of mechanical invention, has caused the scepter of power to pass from the military to the commercial elements of the nation. A hundred years ago historians measured a country's success by battles won or lost, but to-day commercial supremacy is the first material essential to national greatness. Although it is still the "man behind the gun" who will decide the battle, the gun (and a very good gun, at that) must be there, and, for England, the ship to carry it, with all the marvelous complications of machinery that are essential to a modern fleet. It is pointed out that the racial characteristics which have enabled Great Britain to win battles are not necessarily those which furnish the best defense against commercial rivalry.

From this statement the argument passes naturally to a second and more important aspect, in which the present conditions differ from those of the past centuries; this being the increased extent to which other nations are competing with Great Britain in the markets of the world. Nothing like it has ever been seen before, and yet it is more true to day than ever before that England must make and sell, or starve. In that distant period of Queen Elizabeth to which one of the critics of The Times articles referred, the English might shut themselves up in their island and wait for a Spanish Armada, perfectly secure, provided the Spaniard could not gain a footing on their shores. Foreign trade was a small matter then. The country could live without it. So it was, though in a less degree, almost up to a time within the memory of men still living. Rapid interchanges of knowledge, no less than of commodities, however, have leveled distinctions, making the conditions of the race for commercial supremacy alike for all. Great Britain was the first in the field, with a long start in the race. For the greater part of the nineteenth century America was busy peopling her undeveloped territory; Germany, as we now know her, did not exist, and the other manufacturing countries seemed willing to concede to Great Britain the role she had allotted to herself as the "workshop of the world." By the end of the nineteenth century national commerce had become a ruling factor in the extended prosperity that has fallen to all nations; and it is only during a comparatively recent period that other countries have made a determined bid for the share which Great Britain has held in the world's manufacturing industries. It is this which differentiates the present from the previous periods, and gives to the present crises a significance all its own.

CURRENT OF 3,000 VOLTS AT THE MOTORS.

Electric traction on the Italian railroad systems is of special interest, as Italy is not a coal-producing country and fuel is consequently high in price; on the other hand, waterfalls are abundant, and it is quite natural the attention of the railroad companies has been turned toward the use of electricity for traction upon certain of their lines, now that the processes of transmission and utilization of energy have been well established. Among the most interesting projects is that of the Meridional Railroad Company, by which more than 60 miles of railroad are to be operated from a single generating station. For the first time a tension as high as 3,000 volts will be used directly for the motors. The projects of this company are about to be put in execution. The lines included in the system of electric traction undertaken by the Adriatic Company and Ganz & Company, of Budapest, extend to the north of Lecco toward Sondrio and Chiavenna, forming a system of roads which is almost independent of the rest of the system, and placed under conditions as regards traffic. These conditions are such that an important freight and passenger traffic will be developed. It has been necessary, in carrying out the project, to establish freight trains which are relatively heavy, and to separate entirely the freight and passenger systems. According to the project, the passenger trains are to weigh 65 tons, allowing 30 tons for the motor car; the speed will vary between 18 and 36 miles an hour, depending upon the grades, for which 300 horse power will be needed. The freight trains will run at 10 to 20 miles an hour, and the motor car will be able to draw 200 tons of load, the trains being made up of 15 to 20 cars. For the Valteline lines, forming a part of the system upon which will circulate five passenger and two freight trains at a time, the energy is estimated at 2,500 to 3,000 horse power. The road will be operated by a hydraulic plant near the station of Morhegno. A fall of about 100 feet will be utilized, and the water will be carried to the generating station by a tunnel nearly three miles long, cut through the rock. The station is to have three turbine-dynamo groups of 2,000 horse power each. The dynamos are of the three-phase type, of 1,500 kilowatts capacity, giving 15,000 volts. The road is fed by a trolley line, and the high tension wire is carried along the whole extent of the road upon the same posts (except in tunnels). By a series of sub stations located along the road at distances of 6 miles, the tension is reduced to 3,000 volts for the trolley wire. The system of trolley used is of a rather original type, and has been carefully designed to meet the requirements. Two trolley wires are used, and the current is taken into the car by two contact rollers, formed of aluminium cylinders of some length, rolling upon bearings carried by a boxwood shaft covered with insulating substance; the boxwood piece is supported from a heavy cast iron base on the roof of the car by means of a system of articulated bars and springs, so that the rollers are kept well in contact with the wires and can move readily in the vertical direction, while the system is otherwise quite rigid. The motor cars are of two patterns, for freight or passenger service. The former carry four motors of 125 to 250 horse power, being veritable locomotives; the latter have four motors of 75 to 150 horse power; only two of the motors work continuously, the two others being used when it is desired to obtain a greater tractive effort at the same speed. The trains are made up of a motor car and train of 65 tons, and the speed varies between 20 and 35 miles an hour. The trains are electrically lighted, heated and ventilated.

CONSTRUCTION OF THE SIMPLON TUNNEL.

The Simplon Tunnel, whose construction is being actively carried on, will considerably shorten the route from London and Paris to the Suez Canal; the distance from Calais to Milan, which is now 657 miles by the Mont Cenis, and 642 by the St. Gothard, will be only 565 miles by the Simplon. The Ostend-Milan will also be shortened by 57 miles over the distance via the St. Gothard. The agreement for the establishment of a tunnel across the Simplon, from Brigue to Isella, was signed on November 25, 1895, by the Swiss and Italian governments; this agreement gave to the Swiss company of the Jura-Simplon a concession for the construction and operation of the new line. The contract for piercing the tunnel was awarded to Brandt, Brandau & Company, of Hamburg. In reality, the construction includes two tunnels of single track, parallel, and having their axes 52.4 feet distant, uniting near the middle of the course into a single tunnel of 1,230 feet length, of double track, in which the crossings will be made. The first of these tunnels was to be completed in the space of six years, while the second will be taken up only when the traffic of the line exceeds a certain tonnage. The work was commenced August 15, 1898, and there seems to be little doubt that it will be finished within the specified time, or the middle of 1904.

The method of construction employed consists in piercing a gallery for each tunnel; these being united every 600 feet by transverse galleries. The gallery of the first tunnel is then enlarged to the normal section; while the enlargement of the second is reserved for a later period; it is, however, utilized at present for the arrival of the cars, which after being loaded leave by the first gallery, as well as for the evacuation of the water and for ventilation; the latter is carried out on a large scale by two 500 horse power ventilators, operated by turbines, which force the air into the second gallery and it comes out by the first. The ventilators will furnish 1850 cubic feet of air per second, at the pressure of 20 inches of water, which is necessary to drive the air to the extremity of the work. Except the last two, all the transverse galleries are stopped up so that the fresh air arrives to the first gallery at a point near the end. The front of the work proper is, however, outside of the sphere of air-circulation, and a special conduit has been installed which brings 20 to 30 cubic feet per second, kept at a temperature of 8 to 10 degrees C. below that of the walls by a system of water sprinklers. At the maximum working, these may absorb 15 gallons per second. The motive power used in the construction is furnished by the Rhone; a dam has been established at 2½ miles above the entrance of the tunnel, and the water is brought to a hydraulic plant which utilizes a fall of 1,250 feet and a maximum supply of 200 cubic feet of water per second. The turbines are thus furnished with an effective force of 2,230 horse power, which is well above the figure determined for the needs of the boring, ventilation, etc. This plant suffices for the northern entry of the tunnel, and for the southern entry a second plant has been established, utilizing the water of the Diveria, which gives a fall of about 500 feet with a minimum supply of 40 cubic feet per second, representing 1,600 horse power. The following table gives some of the principal data of the tunnel, together with that of the three other main tunnels of the Alps.

	Mont Cenis.	Saint Gothard.	Arlberg.	Simplon.
	Feet.	Feet.	Feet.	Feet
Length of tunnel.....	42.140	49,130	32,590	64,715
Maximum altitude of tunnel.....	4,273	3,795	4,323	2,326
Maximum altitude of the mountain along axis of tunnel.....	9,735	9.438	6.699	9,372
	Degrees C.	Degrees C	Degrees C.	Degrees C.
Interior temperature.	29.5°	30.8°	18.5°	40°