Scientific American.

ESTABLISHED 1845

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

PUBLISHED WEEKLY AT

No. 361 BROADWAY, - - NEW YORK.

TERMS FOR THE SCIENTIFIC AMERICAN.

(Established 1845.)

One copy, one year, for the U. S., Canada or Mexico.....$3.00
One copy, six months, for the U. S., Canada or Mexico..... 1.50
One copy, one year, to any foreign country, postage prepaid, £0 16s. 5d. 4.00

Remit by postal or express money order, or by bank draft or check.

MUNN & CO., 361 Broadway, corner Franklin Street, New York.

The Scientific American Supplement

(Established 1876)

is a distinct paper from the SCIENTIFIC AMERICAN. THE SUPPLEMENT is issued weekly. Every number contains 16 octavo pages, uniform in size with SCIENTIFIC AMERICAN. Terms of subscription for SUPPLEMENT, $5.00 a year, for the U. S., Canada or Mexico. $6.00 a year, or £1 4s. 8d., to foreign countries belonging to the Postal Union. Single copies 10 cents. Sold by all newsdealers throughout the country. See prospectus, last page.

Combined Rates.—The SCIENTIFIC AMERICAN and SUPPLEMENT will be sent for one year, to one address in U. S., Canada or Mexico, on receipt of *seven dollars*. To foreign countries, *eight dollars and fifty cents a year*, or £1 14s. 11d., postage prepaid.

Building Edition of Scientific American.

(Established 1885.)

THE BUILDING EDITION OF THE SCIENTIFIC AMERICAN is a large and splendidly illustrated periodical, issued monthly, containing floor plans and perspective views pertaining to modern architecture. Each number is illustrated with beautiful plates, showing desirable dwellings, public buildings and architectural work in great variety. To architects, builders, and all who contemplate building this work is invaluable.

Single copies 25 cents. By mail, to any part of the United States, Canada or Mexico, $2.50 a year. To foreign countries, $3.00 a year, or £0 12s. 4d. Combined rate for BUILDING EDITION with SCIENTIFIC AMERICAN, to one address, $5.00 a year. To foreign countries, $6.50 a year, or £1 6s. 9d. Combined rate for BUILDING EDITION, SCIENTIFIC AMERICAN, and SUPPLEMENT, $9.00 a year. To foreign countries, $11.00 a year, or £2 5s. 2d., postage prepaid.

Export Edition of the Scientific American

(Established 1878)

with which is incorporated "LA AMERICA CIENTIFICA E INDUSTRIAL," or Spanish edition of the SCIENTIFIC AMERICAN, published monthly, uniform in size and typography with the SCIENTIFIC AMERICAN. Every number contains about 100 pages, profusely illustrated. It is the finest scientific industrial export paper published. It circulates throughout Cuba, the West Indies, Mexico, Central and South America, Spain and Spanish possessions—wherever the Spanish language is spoken. THE SCIENTIFIC AMERICAN EXPORT EDITION has a large guaranteed circulation in all commercial places throughout the world. $3.00 a year, or £0 12s. 4d., postpaid to any part of the world. Single copies, 25 cents.

MUNN & CO., Publishers, 361 Broadway, New York.

☞ The safest way to remit is by postal order, express money order, draft or bank check. Make all remittances payable to order of MUNN & CO.

☞ Readers are specially requested to notify the publishers in case of any failure, delay, or irregularity in receipt of papers.

NEW YORK, SATURDAY, JANUARY 15, 1898.

Contents.

(Illustrated articles are marked with an asterisk.)

TABLE OF CONTENTS OF

Scientific American Supplement

No. 1150.

For the Week Ending January 15, 1898.

Price 10 cents. For sale by all newsdealers.

CYLINDER RATIOS IN MULTIPLE-CYLINDER STEAM ENGINES.

The best ratio of expansion in multiple-cylinder engines has yet to be determined. At present there is considerable divergence of practice. Each builder is guided by his own conclusions, which are based more upon observation than upon any scientific tests. Locomotive builders are awaiting with considerable interest the results of the experimental work which is to be carried out upon the new locomotive at the laboratory of the Purdue University, which has been furnished with high and low pressure cylinders, the latter being bushed to enable various ratios of expansion to be tested. A valuable contribution to our knowledge of this subject has been afforded by a series of tests which Prof. Thurston has lately carried out at Sibley College. The experiments were made on an experimental triple-expansion engine with cylinders 9 inches, 16 inches, and 24 inches diameter, by 36 inch stroke. A compound engine with a cylinder ratio of 3 to 1 was produced by combining the high pressure and intermediate cylinders; another compound with a ratio of 7 to 1 was secured by combining the high pressure and low pressure cylinders; and the engine in its normal condition was used for the triple expansion tests.

The results were in some respects surprising, although previous experiments with the Rockwood compound engine had shown similar results. The diagram showing steam consumption per indicated horse power proves that at about 37 horse power the steam consumption was about the same in each case. Above this the 3 to 1 compound showed a minimum steam consumption of 18 pounds per horse power per hour at 75 horse power. The minimum steam consumption for the 7 to 1 compound was 15·8 pounds, and for the triple expansion engine 13·7 pounds. The efficiency diagrams showing the variation in steam for dynamometric or delivered horse power show that the triple expansion engine was most economical under loads of from 115 to 120 horse power; but strange to say, the 7 to 1 compound consumed less steam per horse power at loads under 85 horse power and less steam than a 3 to 1 compound at loads above 72 horse power. Mr. Thurston further proved that the most economical ratio of expansion for the 3 to 1 compound is 12 and 21 for the triple expansion engine. For the 7 to 1 compound the best ratio would probably be about 17. The conclusion is drawn that, after making all allowances, the triple shows an economy over the 7 to 1 compound of over 1 pound of steam per horse power per hour, and that a still larger gain is made by the 7 to 1 compound over the 3 to 1 compound.

ELECTRIC LOCOMOTIVES AT TERMINAL STATIONS.

Although the day when the electric will supplant the steam locomotive on trunk lines may be quite remote, it is steadily encroaching upon its domain in certain branches of locomotive work. The latest evidence of this comes in the shape of an announcement that the handsome Union Depot at Boston is to make use of electric locomotives and that no steam traction will be used within a mile of the station. The steam locomotives will bring their trains up to the electric yard, where they will be picked up and brought in by the electric locomotives. Outgoing trains will be similarly handled, being picked up by the steam locomotives at the limits of the electric yard. The proposed scheme is an excellent one and could be adopted by the existing terminal stations to great advantage. Though it might involve a slight delay and greater cost of operation, the gain to the traveling public and the locality surrounding the great terminals would be valuable in many ways. The handsome terminal structures themselves would be healthier and more cleanly. Any traveler with an eye to the artistic must have noticed how speedily the fresh painted ironwork of such a terminal as the Grand Central Station in New York, or the Pennsylvania Railroad Station in Philadelphia, is begrimed by the gases from the locomotives. With the substitution of electricity the handsome train shed roofs would preserve their proper coloring and the light, graceful effect of their ironwork indefinitely. In the yards, moreover, the noisy exhaust of the switching engines would give way to the quiet hum of the motor—a change devoutly to be wished by the residents of the adjoining districts, who would at the same time be rid of the smoke and ashes that add their quota to the general inconvenience. When the approach to the terminal is in tunnel, as in many of the European cities and here on Manhattan Island, the purifying of the atmosphere due to such a change is too obvious for comment.

Before leaving this subject, it should be noted that an electric switching locomotive has this week made a successful trial on the Hoboken Shore Road, New Jersey. It has been built for hauling heavily loaded freight trains between the railroad terminals and the wharves of the transatlantic liners at Hoboken. The locomotive, which is eight-wheeled, develops a total horse power of 540 on four axles, each motor being of 135 horse power. The substitution of electric for steam traction will prove a great boon in the populous district affected by it.

FORETHOUGHT IN THE CONSTRUCTION OF DRYDOCKS.

The figures which have been given out respecting the new additions, costing $5,000,000, which are to be made to the dock system of Liverpool are very significant. The most striking feature is a new drydock which is to be 920 feet long, with an entrance 94 feet wide. Other contemplated improvements, whose total cost will be $16,500,000, include the enlargement of a dock which is now 475 feet long to a length of 1,000 feet and the construction of two others which will be respectively 620 and 630 feet in length. It is probable that, before determining the length of the new docks, the authorities consulted the owners of the transatlantic steamship lines which run to Liverpool, and that these vast dock dimensions have been determined by the great size of the ships which these companies have in prospect. The time is drawing near when the public will be looking for an answer on the part of the Cunard Company to the "Kaiser Wilhelm der Grosse" and the "Oceanic," and it would not be surprising if their next pair of ships had a deck length of from 725 to 750 feet. It is interesting to note in this connection that the new Liverpool dock could accommodate the White Star liner "Oceanic," 704 feet in length, with 216 feet to spare.

AROUND THE WORLD IN TWENTY-EIGHT DAYS.

When Jules Verne wrote his fascinating book, "Around the World in Eighty Days," he set a mark which the public has evidently agreed to use in noting any advance in the speed of circumnavigating the world. The writer aimed to show the very utmost that could be accomplished by the means of transportation of his day, and at the time the book came out it had all the possibility and improbability which characterized the other works of the author. In less than a quarter of a century, however, the feat of touring the world in eighty days has not only passed out of the realm of fiction into that of fact, but we find ourselves within a few years of the day when the ordinary tourist can make the trip in less than half of eighty days. This will be possible just as soon as the Trans-Siberian railroad is completed, or early in the twentieth century.

The Russian minister of communication, M. Chilkov, has stated that when the great railroad is opened the tour of the world can be completed in thirty-three days, the various divisions of the journey being covered as follows:

Bremen to St. Petersburg	1½ days.
St. Petersburg to Vladivostok	10 "
Vladivostok to San Francisco	10 "
San Francisco to New York	4½ "
New York to Bremen	7 "
Total	33 "

These figures are evidently based upon the actual running speeds of the various transportation lines, and an estimated speed of about 25 miles an hour from St. Petersburg to Vladivostok.

There is no doubt that even this time could be greatly reduced if the speed of the trains, and to a less extent of the ships, were not kept down by considerations of economy.

If any one were to set out to complete the circuit of the globe in the least possible time that modern transportation, in the shape of existing ships and railways, is capable of, irrespective of cost, it would be possible to reduce the estimate of M. Chilkov by five days at least.

In the figures given below it is assumed that the traveler has the services of the fastest existing ships on the ocean, and that the trains are run at the highest rate of speed consistent with the gradients, curvature and condition of the roadbed, in the various districts passed over. Thus the "Kaiser Wilhelm" would be available for the Atlantic passage, with her speed of 22·34 knots per hour, and a 20 knot ship is assumed for the Pacific passage. To maintain the high averages of the special trains chartered on the railroads, it is assumed that speeds of from 60 to 70 miles an hour would be maintained on the plains to compensate for time lost in crossing the mountain divides. What can be done with special facilities is shown by the fast runs which are frequently made in this country and in England.

The probable best time that could be made by chartering special trains would be about as follows:

Route.	Miles or Knots.	Speed per Hour.	Time in Hours.
New York to Plymouth	2,990	22·35 knots.	133·8
Plymouth to London	194	60 miles.	3·2
London to Moscow	1,800	50 "	36·0
Moscow to Tcheliabinsk	1,100	40 "	27·5
Tcheliabinsk to Vladivostok	4,500	37 "	121·6
Vladivostok to San Francisco	5,400	20 knots.	270·0
San Francisco to Omaha	1,864	40 miles.	46·6
Omaha to Chicago	493	50 "	9·9
Chicago to New York	998	60 "	16·6
			665·2

This gives a total of 27 days 17 hours for the whole journey. If 7 hours be allowed for delay in transfers,