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 16s. 5d. 4.00

THE SCIENTIFIC AMERICAN PUBLICATIONS

Scientific American (Established 1845) ....$3.00 a year
Scientific American Supplement (Established 1876)............... 5.00 "
American Homes and Gardens.................................... 3.00 "
Scientific American Export Edition (Established 1878)........... 3.00 "

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MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, OCTOBER 13, 1906.

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.

A FORECAST AND ITS FULFILLMENT.

In an article published several years ago in the columns of this journal, we dealt with the question of the rapid increase in size and speed of transatlantic steamships, and showed to what extremes the dimensions of a ship would have to be carried to enable her to steam across the Atlantic at an average speed of 30 knots an hour. It was shown that the great demands made upon the displacement by the weight of the motive power and coal, rendered it necessary to increase the length to 930 feet, and we pointed out that this great length, coupled with the high speed at which the ship was to be driven in all weathers, would call for special construction in the hull, particularly to withstand the excessive longitudinal bending stresses to which the vessel would be subjected when she was being driven into a head sea. To meet these stresses and provide suitable longitudinal girder strength to the hull, it was proposed to double the skin plating at the sheer strakes (the topmost line of plating), and also to double the plating at the turn of the bilges, thereby transforming the sides of the ship into two huge plate girders, having the customary massing of material at the top and bottom chords. Further to strengthen the vessel, we suggested the advisability of running a continuous longitudinal plate-steel bulkhead through the vessel, extending from the keel to the main deck and similarly doubling the strakes of plating at this deck and at the keel, the bulkhead to extend from the after end of the engine room to the forward transverse bulkhead of the boiler space.

With considerable interest we now note in the descriptions of the construction of the new 785-foot Cunarders, that in view of the heavy hogging and sagging stresses due to their length, to which they will be subjected, this very method of stiffening has been adopted. Thus, although the shell plating of these ships is unusually heavy, the plates being not less than 34 feet long and from 2½ to 3 tons in weight, at the sheer strakes and at the turn of the bilges the plates are doubled and are made 40 feet in length and from 4 to 5 tons in weight; moreover they are made of high tensile steel with a strength of from 36 to 40 tons per square inch.

Although the fact that ships of great length are subjected to enormous bending stresses in a seaway has been long known to naval architects, the general public has little idea how severe these stresses can be. When the ends of a ship are wave-supported the vessel sags at the center; when the wave is at the center and the ends are comparatively unsupported it is the ends which sag; but it was only when the transatlantic liner had reached a length of over 600 feet that the effects of this longitudinal bending began to be seriously manifest. It revealed itself in the topmost decks, where rivets would be sheared, steam or other pipes broken, and plates buckled. To provide for the alternate lengthening and compressing of the decks they are now cut in two or more places and sliding joints are provided. Several years ago the writer was on one of the fastest of the German boats when she was being driven, head-on, into a westerly gale, under her full horse-power of 37,000, "just to see what she could do." For a while, until the green seas began to smash things up rather badly forward, she did 21 knots an hour. During this trial the sliding joints in the topmost deck showed a total movement of from five-eighths to three-quarters of an inch, the joints closing up as the ship buried her head in an oncoming sea, and opening out as the wave moved to amidships; while on the deck below, the plating showed signs of buckling, and the oakum was squeezed entirely out of the butt joints in the deck planking.

As to the future, it is certain that ships will continue to grow in length, until our suppositional ship of 930 feet length will be equaled and exceeded. By that time it will become necessary, we think, to introduce the central longitudinal bulkhead, with top and bottom stiffening, as suggested in the article referred to. The cutting of the necessary openings in this bulkhead for dining rooms and passages, could be done without in any way affecting the girder strength of the bulkhead. As to whether a liner will ever be built to cross the Atlantic at an average speed of thirty knots it is difficult to foretell. Apart from the question of channel and dock accommodation, the difficulty will lie with the motive power. The new Cunarders are bound by contract to make a trial speed of 25¼ knots. They will probably reach 26 knots; but it is a far, far cry from 26 knots to 30. The solution of the problem is "up to" the steam turbine, and the steam turbine as installed in the larger ships has not shown sufficient economy in weights and steam consumption over the reciprocating engine, to warrant us in believing that it will be equal to the task. The steam turbine of 20,000 horse-power and over is, however, at present, in its infancy, and will no doubt, in these larger sizes, show better results in the future. Perhaps the solution of the 30-knot four-day liner lies after all with the propeller; for if we could prevent the present loss back of the thrust block, a 30-knot boat would easily become an accomplished fact.

NEW METHOD OF RIVER TUNNELING.

The system of tunneling through the beds of rivers, estuaries, or other waterways, by digging a trench and constructing the tunnels therein, is to be utilized on a large scale in the important double-tube tunnel for carrying the tracks of the Michigan Central Railroad beneath the Detroit River, contracts for which have recently been let. We are indebted for the broad principle of tunneling by the trench method to Contractor McBean, who made use of it in building the double-tube tunnel of the New York Subway beneath the Harlem River. In the system to be used at the Detroit River the trench is retained, but the tunnel is formed by sinking two lines of steel tubes and inclosing them in a single monolithic mass of concrete. The design is a modification of that proposed by Vice-President Wilgus of the New York Central Railroad, the preliminary plans for which were described in a recent issue of this journal. The Detroit River tunnel will be built in a trench which will be excavated by floating dredges, and will be wide enough to accommodate two full-sized railway tunnel tubes lying side by side. Piles will be driven in the bottom of the trench, cut off at the proper height, and capped with transverse steel beams, upon which will rest the tubes. A layer of sand and gravel, with the addition of cement, if necessary, will be laid on the bottom of the trench, filling the spaces between the tops of the piles and also the transverse beams, and being finished off flush with the tops of the beams. Upon the steel beams and bed of gravel and concrete will be sunk two lines of tubing, built of ⅜-inch steel plate. The tubes will be built generally in lengths of 263 feet. At every 12 feet of their length they will be reinforced by plate-steel diaphragms, and they will be sunk to their places from scows or temporary platforms. The spacing of the lines of piles and of the exterior diaphragms of the tubes will be such that the diaphragms will rest upon the beams when the tubes are in place. The end of each tube will be provided with a sleeve which, as the tube is sunk, can slip over the end of the adjoining tube. By means of rubber gaskets the tubes can be bolted up, forming air-tight annular joints; and into these joints cement grout will be flowed from the scows or platforms at the surface of the water. The trench will then be filled in with concrete until the tubes are completely buried, the surface of the concrete being finished off at the low-water depth required by the War Department. After the concreting is completed, the water will be pumped out of the tubes, leaving two complete tunnels permanently buried in the bed of the river. The system, as thus described, has many features to recommend it, one of which is that it obviates the necessity for the use of the troublesome and risky pneumatic process as employed under the North and East rivers of this city. Furthermore, it becomes possible to build a tunnel nearer to the bed of the river, thereby decreasing the grades on the approaches and reducing the cost of subsequent operation.

GROWING PROSPERITY IN AGRICULTURE.

Apropos of the recent advice of James J. Hill to the people of the United States, that they should cultivate scientific farming, reference to which was made in our issue of September 29, we note that the last Bulletin of the Department of Agriculture contains much timely and encouraging information. It is announced by the department, and abundant figures are given in proof of the statement, that the farmers of the United States are enjoying unwonted prosperity, the farm lands of the country being held in such high value that it is now difficult to secure cheap land, or free, for cultivation. The Bulletin, which bears the title "Changes in Farm Values," contains a table showing the difference in the average value of farms, by the acre, throughout the country in the five years that have elapsed since 1900, from which we learn that in the State of New York farms of medium equipment have jumped in value from $43.58 an acre in 1900 to $51.54 in 1905.

The farming interests, especially in the past few years, have assumed an importance in the world of finance, transportation, and manufacture which is growing steadily the passing years. The causes underlying this prosperity are many, and chief among them should be mentioned the fact that the free or cheap lands of the Federal government, or of the States and railroads, have become practically exhausted, if we except the arid lands which must become the subject of irrigation to render them fruitful. The exhaustion of these lands has come so unexpectedly as to produce something of a mild crisis in the broad field of agriculture. Another element which has contributed to raise the price of farm lands has been the steady gain of city upon country population, whose effect has been to show in the government statistics a continual gain of demand upon supply; and this, in spite of the fact that both the amount and the value of agricultural exports have remained at a high figure. It would look as though our farmers have to-day reached a period of reasonable, if not high, prices, which they may confidently rely upon as being permanent. The beneficent result of these influences upon the condition of the farmers has been marked, and promises to be permanent. "Farming," says the report, "has assumed a new and higher dignity. Farmers have extinguished their old debts; they have accumulated surpluses, and have become depositors in banks and the owners of bank stocks; they have bought more land, not only agricultural land, but real estate in the towns, and they have sent their savings to distant States for investment in agricultural land. At the same time, the town investor has had his attention excited by the new situation, and has thrown upon the country real estate market vast sums for investment."

Although this Bulletin has a highly optimistic flavor, which it has indeed every right to carry, there is nothing in it to contradict the grave truths outlined in the recent address of Mr. Hill at Minneapolis, in which he emphasized the necessity for scientific farming as a means of increasing the output of the farms, and providing for the future enormous increase of the population of the United States. Although the Bulletin admits that there has been "a gradual and steadfast improvement in the practice of farming," it is nowhere so well understood as in the Department of Agriculture that the natural productivity of the soil is only half developed, and that the land simply awaits more intelligent and careful farming to double its output.

WHAT IS THE INTERIOR CONDITION OF THE EARTH?

Few papers read before the British Association for the Advancement of Science have attracted such wide attention or aroused such warm discussion among physicists as the address delivered by Mr. R. J. Strutt on "Radio-Activity and the Internal Structure of the Earth." Lord Kelvin, the Nestor of British scientists, in a letter published in the London Times protested against "the hypothesis that the heat of the sun or earth or other bodies in the universe is due to radium," and reasserted his conviction that planetary and solar heat is due to gravitation. When one recalls his brilliant amplification of Helmholtz's theory that a contraction of the sun amounting to about ten inches a day would be sufficient to account for its present heat, one can readily understand his position. On the other hand we have no more reason to suppose that gravitational energy is responsible for terrestrial and solar heat than we have for attributing to radium the temperature observed. The question whether or not the sun is actually shrinking can hardly be definitely answered for a century or more.

Strutt's calculations are certainly plausible, even though we may not be ready to accept his radium theories entirely. The poorest igneous rock which he examined, namely, Greenland basalt, contains more than ten times the proportionate quantity necessary to uphold the assumption that the earth's heat is due to radium alone. Because there is too much radium in the earth, Strutt has been forced to the conclusion that the interior of the globe does not contain radium. His data for the quantity of radium in rock point to a thickness of at most forty-five miles for the earth's crust, and that the internal temperature at the bottom of the crust is about 1,500 deg. C. To these views it may be objected that the diffusion of radium may have some effect on its property of radiating heat. Indeed, Sir William Crookes has tentatively shown that a molecule of radium locked up in a mass of rock and compressed in the interior of the earth would not throw off the heat-generating alpha particles, but would remain in a state of suspended animation, his data having been obtained in experimenting with powdered compressed pitchblende.

To involve the problem still more, we must take