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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.

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 into consideration the existence of thorium, uranium, and other radio-active substances discovered and undiscovered.

Curiously enough, Strutt's theory necessitates an assumption of the internal structure of the earth, that is quite in harmony with the prevailing views of geologists. Strutt finds that the inside nucleus, heated by the crust of radium-containing material, must be at a uniform temperature of 1,500 deg. C. throughout, just as a loaf of bread, which has been in an oven long enough, acquires a steady temperature equal to that of the walls of the oven. Strutt's crust would contain about one thirtieth of the earth's volume, and if throughout it the radium heat energy were of the average of that exhibited by many samples examined by him, the temperature of the earth could be maintained until our stores of uranium suffered sensible depletion. Such an assumption would lead to the conclusion that the whole of the central portion of the earth consists of non-radioactive substances at an approximate uniform temperature somewhat below the melting-point of platinum. Prof. Griffiths has examined the proofs of this supposition at our disposal, and we here present a summary of his findings.

Prof. George Darwin has stated that the rigidity of the earth is at least as great as that of steel. Hough arrived at substantially the same conclusion by a different method. To Oldham's mind the evidence pointed to a central metallic core and to the existence of marked differences in the physical constants of the core and the surrounding crust. Prof. Milne's recent investigations have led him to the conclusion (based on the difference in the rate of propagation of earthquake waves) that the material below a depth approximating to thirty miles is of a uniform nature, and that the change in physical constitution is abrupt. Geodetical observations conducted by means of plumblines and pendulums have convinced Col. Burrard that we are not justified in asserting the non-existence of deep-seated variations in density, but that we are justified in believing that the variations in density which have been discovered are apparently superficial.

The agreement of results drawn from such dissimilar sources is certainly striking. It is possible that the evidence from each source, considered independently, might be regarded as inadequate, but the cumulative effect is sufficiently strong to justify the belief that some marked physical change in the constitution occurs at a depth of some thirty to fifty miles. At all events, we have indications that, with the exception of a comparatively thin crust, the earth consists of a non-radio-active substance with a rigidity approaching that of steel, with an average temperature in the neighborhood of 1,500 deg. C.

RESULTS OF THE FIRST INTERNATIONAL BALLOON RACE.

The Aeronautic Cup contest for spherical balloons has proved to be one of the leading events of the season. It was organized under the direction of the Aero Club of France for September 30, with the large space of the Tuileries Gardens, in the heart of Paris, as the starting point. The cup offered by Mr. James Gordon Bennett for the longest distance covered by a balloon is a handsome work of art in massive silver having a value of $2,500. It is to be held by that club whose representative is the winner. The other prizes are as follows: For the first prize, the sum of $2,500, also one-half of the engagements, or for this year $400, making a total of $2,900. The second prize includes one-third the engagements for 1906, or $246; and the third prize the remainder, or $133. Among the other prizes are a silver medal offered by the Aero Club of the South-east, the medal of the journal L'Auto, the prizes for meteorological work offered by the scientific commission of the Aero Club, and the Meteorological Association of France, etc., also a series of medals from the Aero Club. At the same time a balloon can compete for the Santos Dumont prize of $800 for the first trip of 48 hours in the air.

Of the sixteen contestants, three each were English, French, German, and Spanish, while the remaining four consisted of two Americans, one Italian, and one Belgian. Seven of the contestants succeeded in crossing the English Channel and landing at various points in Great Britain, while the remaining nine were content with landing in France without attempting the trans-channel journey. The race was won by Lieut. Frank P. Lahm, of the Sixth United States Cavalry. Lieut. Lahm and M. Santos Dumont represented America, and the former, who was accompanied by Major Hersey, of the United States Weather Bureau, covered 485 miles in about 23 hours, and finally landed 7 miles south of Whitby, on the east coast of England, at 3 P. M., October 1. This distance in a straight line from Paris was about 415 miles, although the course actually traversed was some 70 miles longer Although both Lieut. Lahm and his companion were amateurs at ballooning, they were able to take advantage of the latter's knowledge of meteorology and, by a careful study of the weather maps, to know what course to pursue when they were once in the air. The balloon trip was fairly rapid, as an average speed of 21 miles an hour was maintained. The balloon rose at first to an altitude of 3,000 feet, and was carried by a fair breeze in the direction of Havre. After a while the air current lessened, and the aeronauts dropped to about 1,500 feet in order to obtain a better current. Upon nearing the English Channel, they descended still lower, and crossed the latter with the trail rope dragging in the water, and at an elevation of not over 300 feet. The crossing of the Channel occupied four hours, from 11 P. M. until 3 A. M. the following morning. France was left at Caen, and England was reached near Chichester. The average speed while crossing was 25 miles an hour. Not until noon of the following day did their balloon, the "United States," ascend to any very great height. At this time the aeronauts threw out ballast, and allowed it to ascend to an elevation of nearly 10,000 feet. The wind carried them in a northwesterly direction, and finally brought them to the east coast, near which the landing was effected. This was Lieut. Lahm's fifteenth ascent, and it was a most successful trip. His balloon was of French manufacture. It had a capacity of 22,500 cubic feet, and was constructed of varnished cotton cloth. The other American balloon, "Les Deux-Amériques," manned by Santos Dumont, met with an accident and got no farther than Broglie, some 80 miles northwest of Paris. The noted experimenter had his balloon equipped with a 6-horse-power gasoline motor arranged to drive two horizontal propellers mounted in a frame on the side of the basket. The propellers were intended to serve the purpose of the usual ballast, and to raise or lower the balloon as the aeronaut wished.

While starting the motor in order to send his balloon to a higher altitude, M. Dumont caught his coat sleeve in the machinery, ripping it and slightly lacerating his arm. Consequently, he landed and returned to Paris.

The balloon which went the second greatest distance was the Italian aerostat manned by Alfredo Vonwiller. This balloon, the "Elfe," covered about 370 miles and landed in England near New Holland, a small town on the river Humber opposite Hull.

The balloon which covered the third greatest distance was the "Walhalla," the large aerostat of that experienced amateur aeronaut, the Count de la Vaulx. This balloon landed at 1:30 P. M. October 1 in Walsingham, near Norfolk, England. The distance it covered in a straight line was about 285 miles, but the actual distance traversed was about 435 miles, and the highest altitude reached about 7,500 feet.

One of the English balloons, the Hon. C. S. Rolls's "Britannia," of 78,000 cubic feet capacity, remained in the air the longest of any of the air craft, its record afloat being 26¼ hours. The landing was made at Sandringham at 6:30 P. M., October 1. The "Britannia" was fourth in the contest. Another English balloon, the "Zephyr," of Prof. Huntington, was 8 hours in crossing the Channel, but it finally landed safely at Sittingbourne, Kent, and obtained sixth place.

The third English balloon, piloted by Frank H. Butler, went only as far as Blonville on the north coast of France. This balloon, the "City of London," like its two English mates, was of 78,000 cubic feet capacity. It obtained twelfth place in the contest.

M. Jaques Balsan's French balloon crossed the Channel and landed at Singleton, Isle of Wight, at 4 A. M., October 1, thus obtaining fifth place.

Capt. Kindelan in a Spanish balloon was seventh, he having landed at Chichester, England. Eighth place was obtained by Herr Scherle, representing Germany, who landed at 11:30 P. M., September 30, at Dieppe. Another Spaniard, Emilio Herrera, was ninth. He landed half a mile from the coast between Cabourg and Dives-sur-Mer at 10:38 P. M., September 30. Tenth place was secured by Capt. Von Abercorn, of Germany, who landed at Villers-sur-Mer at 11:15 P. M., September 30. Signor Salamanca, of Spain, was eleventh. His balloon came to earth at Blouville-sur-Mer at 11 P. M. Count de Castillon de St. Victor was thirteenth. He also landed at Blouville-sur-Mer at 11:30 P. M. He stated that the wind was too uncertain for him to attempt to cross the Channel. Fourteenth, fifteenth, and sixteenth places were gained respectively by Baron von Hewald, of Germany (who landed at Conde-sur-Lisle, near Point Audemer, at 11 P. M.), by Santos Dumont, and by Van den Dresche, representing Belgium, who landed in Brittany.

The contest is remarkable from the fact that no serious accident occurred to any of the balloons. Santos Dumont's aerostat was the only one which was at all out of the ordinary as regards its equipment, and it was due to the slight accident mentioned above that this daring aeronaut found it necessary to give up the contest. The Italian balloon of Alfredo Vonwiller had some difficulty in alighting, as a gust of wind drove the balloon at a high rate of speed over a number of fields before the anchor caught. Finally, however, the anchor caught in the garden gate of a country house, bringing the balloon up suddenly against the side of the house and damaging the chimney and roof slightly. Fortunately, no one was hurt.

That sixteen balloons, carrying twice that number of aeronauts, could make such successful flights seems to show the safety of ballooning as a sport, provided the aeronauts are sufficiently experienced. The chief result of the race, however, and the one for which Americans should congratulate themselves, is that the race was won by an American and that, consequently, the next race will be held in this country. It has been officially stated at the Aero Club of America that the race of 1907 will be open not only to balloons proper, but also to dirigible balloons, aeroplanes, and other types of flying machines. Thus there will be presented a grand opportunity for American inventors to perfect their apparatus in time for the next race which, in view of what has already been accomplished in this country, will doubtless be won again by America.

LEVAVASSEUR'S GLIDING BOAT.

A new form of gliding boat has been constructed at Paris by Messrs. Levavasseur, the well-known motor manufacturer, and Lein. In its main points the new apparatus consists of a front boat of light and pointed construction which contains the motor and its accessories. Connected with the rear of the boat by a short, light wood frame about two feet long is a large flat construction in the form of a tail, which extends for some thirty feet back in the water. The rear end of the tail is almost submerged, while the front end, and also the boat, appears to float on the surface and is almost lifted out of the water under the action of the propeller. The latter is placed in the tail portion and a shaft runs back from it to the motor in the front boat. The motor is the new 50-horse-power 8-cylinder "Antoinette" motor, of the Levavasseur construction. The present system is claimed to have the advantages of a sliding boat as well as those of an ordinary boat, that is, it is able to run in rough water, at moderate speed. In calm water it glides very rapidly on the surface.

SCIENCE NOTES.

There is no more important group of questions demanding attention from the chemist at the present time than those connected with the production of India-rubber or caoutchouc. An enormous increase in the demand for India-rubber has taken place in the last few years, and last year the production was not less than 60,000 tons. Until recently the supply of rubber came chiefly from two sources—the forests of Brazil, which contain the tree known as *Hevea brasiliensis*, furnishing the Para rubber of commerce which commands the highest price, and the forests of Africa, where climbing plants, generally of the Landolphia class, also furnish rubber. The increased demand for caoutchouc has led to the extensive planting of the Para rubber tree, especially in Ceylon and in the Federated Malay States. Systematic cultivation and improved methods of preparation are responsible for the fact that the product of the cultivated tree, which begins to furnish satisfactory rubber when six or seven years old, is now commanding a higher price than the product of the wild tree in Brazil. It is estimated that within the next seven years the exports of cultivated India-rubber from Ceylon and the Federated Malay States will reach between ten and fifteen million pounds annually, and that after fifteen years they may exceed the exports of the so-called wild rubber from Brazil.

Some valuable natural history acquisitions have recently been secured by various zoological institutions in Great Britain. An extensive collection of chimpanzees, two of which were brought from Africa, are of more than passing interest. One belongs to a hitherto unknown species, the face being cream-colored, while the other, which is of a rare species, is known as a "koolokamba." It has a shaggy coat jet black in color, with the hair hanging over the hands like mittens. The head is quite bald, and its size is somewhat abnormal for this race. It receives its curious name from the peculiar guttural sound it makes and which signifies "the animal that speaks." The London Zoological Gardens have received twelve specimens of the "leaf insect," so called on account of its curious and striking likeness to a leaf, which it resembles in every respect—shape, color, veining, and texture being identical. This strange insect comes from a damp climate, and in order to keep the specimens moist, they have to be continually sprayed with water. These gardens have also been presented with two specimens of the white ibis, which is rapidly becoming extinct. These were secured by Lord Crawford during his recent seven months' cruise round South Africa and the Mozambique Channel, by permission of the Hon. Walter Rothschild, from Aldabra, who some time ago secured a lease of the island from the government, in order to preserve these rare birds. During the same voyage Lord Crawford collected about five hundred specimens of rare birds, which have been presented to the British Museum, to be mounted for the national collection.