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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.

MISHAP TO THE SANTOS-DUMONT AIRSHIP.

There will be general sympathy with M. Santos-Dumont, the persistent and plucky aeronaut, in the disaster which overtook him just at the very time when he seemed to have the Deutsch prize within his grasp. He started from St. Cloud and sailed directly for the Eiffel Tower, covering the distance of 9 kilometers, or over 5 miles, in the remarkable time of 9 minutes and 20 seconds. Reports of the trip are somewhat contradictory; but it would seem that, shortly before reaching the tower, the balloon commenced to deflate and the pointed bow began to give way under the end-on resistance of the air. The airship was deflected from its course, but by the skill of M. Santos-Dumont it was brought back and made the circuit of the tower successfully. The further deflation of the balloon seems to have caused some of the suspension ropes to slacken up and become entangled and broken by the propeller. Luckily for the aeronaut, the machine descended upon the roof of one of the taller buildings of Paris and hung there, M. Santos-Dumont being rescued without any injury to himself. The accident is ascribed by the inventor to the imperfect inflation of the balloon, coupled with the varying direction and strength of the wind. He states that he was already returning over the Bois de Boulogne when the wind freshened suddenly and struck him sidewise, causing the balloon to pitch and roll heavily.

Although it is quite possible that the inflation may have been incomplete and the regulating valves faulty, it seems to us that the immediate cause of the failure was to be found in the action of the wind; and it is just here that all airships of the balloon type encounter their most frequent cause of disaster. In running with the wind the aeronaut experienced no practical reverses, and, indeed, the remarkable time made—between 30 and 40 miles an hour—would indicate that as long as the wind was with him, and the opposing pressure of the air was simply that due to the speed of the balloon as developed by the propellers, the airship was entirely within his control. It was when he faced the wind that his troubles began.

Without throwing the least discredit upon the ingenuity, skill and perseverance of M. Santos-Dumont, the recent accident really confirms our opinion that the successful airship, aeroplane, or flying machine must, in the nature of things, dispense with the gas-inflated balloon. By the term "successful airship" we mean one which can take its place in the great world of transportation, and hold its own with the railroad train, steamship, or automobile, for the conveyance, if not of freight, at least of passengers. Such an airship must, like the modern first-class steamship, be comparatively independent of the elements. It must not only be able to show a speed of from 60 to 80 miles an hour, with the wind, but it must be capable of maintaining a speed, say, of not less than 30 or 40 miles an hour against the wind, even when the strength of the latter is from 30 to 50 miles an hour. This, we believe, is something that the gas-supported airship will never accomplish, and for the reason that to overcome the end-on resistance and skin friction presented by the large cross-section and surface area of the balloon to the air, the propelling machinery would have to be of a power and weight greatly exceeding the lifting capacity of the balloon. Let us take, for example, the machine that was recently wrecked in Paris. It is supported by a cigar-shaped balloon, which has a length of 110 feet, and a diameter of 20 feet. The cross-sectional area would be 315 square feet, and the maximum pressure of the wind which the balloon might have to encounter would be, say, 40 pounds to the square foot, this being about the pressure of the wind allowed for in calculating the wind stress on bridges and framed structures. The fact that the balloon is cigar-ended is offset by the large skin friction; but to be conservative we will suppose that the maximum pressure parallel with the longer axis would be only three-fourths of this, or 30 pounds to the square foot. This would amount to an end-on pressure of 4¾ tons on the balloon alone. It is not necessary to follow the calculation any further, as it is evident that in the present state of the mechanical arts there is no form of motor which could develop the necessary power within the limits of weight that can be carried by a balloon of this size.

To look at the question from another side: Even supposing that machinery could be designed which would not merely hold the balloon stationary against a gale of wind, but drive the ship forward at a fair speed, it is certain that there is no form of balloon construction known which could encounter such wind pressures without collapsing. It might be answered: "Make the balloon stronger," but to do this would be to increase weight, and a larger gas-holding capacity would be necessary to support the increased load. As far as we know, no gas-supported machine has yet been built that was able to make good progress against a strong wind, and the considerations quoted above show the inherent difficulties of the task.

Under the present conditions of aeronautics it must be admitted that, although the effort of inventors is at present almost entirely directed to the balloon airship, the true solution of the problem would seem to lie where nature suggests that it does lie; namely, in the direction of the aeroplane, a type of airship whose principles are identically the same as those which underlie the flights of birds. What are experimentalists in this most scientific and promising field doing in these days? We hear but little of them. It is possible that they have been discouraged by the extreme risks which attend all aeroplane experiments that are carried out on a large scale. The death of Lilienthal and other martyrs to a fascinating and dangerous science has not, however, proved that aeroplane navigation is impossible; quite the contrary. What it has proved is that the aeroplane only awaits the invention of some automatic means of balancing to render it one of the most successful inventions of the twentieth century.

BIG SHIPS AND DEEP WATERWAYS.

The arrival of the great steamship "Celtic" in the port of New York shows the wisdom of the liberal appropriations recently made by the United States government for providing the harbor of New York with a 40-foot channel from the docks to deep water outside the bar. It is evident, in considering the question of the dimensions of future steamships, that they will be limited only by the harbor and dockage facilities afforded them. The city of New York recently constructed a set of piers with the unprecedented length of 800 feet, and yet they had scarcely been completed before the "Oceanic," with a length of 705 feet, was tied up alongside of them. And now we have but just commenced to dredge out our 40-foot channels, when a vessel enters our harbor with a maximum designed draft which will leave only a few feet margin between its keel and the bottom of the channels when they are finished.

At the time of the launch of the "Celtic" the question of the economics of big ships was very ably discussed by our contemporary, The Shipping World, of London, and facts were given, showing that with every increase in the dimensions of the large freighters there was a corresponding decrease in the cost of transporting freight. The most costly item in the running of these ships is fuel, which, for a vessel of 8,000 or 9,000 tons displacement, is reckoned at about $2.10 per mile steamed; the wages, provisions, upkeep, repairs, interest on capital, etc., costing about 60 cents per mile steamed. As the result of returns covering a large number of voyages, it has been shown that a 4,000-ton steamer, steaming 269 miles per day, consumed 0.081 pounds of coal per ton of displacement per mile; a 5,000-ton steamer traveling 260 miles a day burned 0.067 pounds; a 7,000-ton steamer running 264 miles a day consumed 0.048 pounds; while a 9,000-ton steamer steaming 267 miles burned only 0.036 pounds of coal per ton of displacement per mile. From these figures it is seen that the larger the steamer the less the coal consumption *pro rata*—in fact, that doubling the size of the steamer halves the coal consumption per ton. The significance of these facts is evident when we remember that the coal expense represents about 60 per cent of the total running expense of a ship.

In a paper read before the Institution of Naval Architects, on "Large Cargo Steamers," Prof. Biles has stated that as the result of his investigation of the effect of increase of size upon working expense he was led to the following conclusion: "Taking a steamer 500 feet long, 60 feet broad, with a depth of 27 feet, 6 inches, I find that by increasing the length to 700 feet, with a proportionate increase of the breadth, but keeping the draught stationary at 27 feet 6 inches, the cost of carrying a ton of cargo 5,000 knots at 12-knot speed, increases from $2 to $2.75. But if the draught, instead of being kept constant, is increased in proportion to the increase in the other dimensions, the cost of carrying a ton of cargo the same distance at the same speed, decreases from $2 in the case of a 500-foot ship, to $1.75 in the case of the 700-foot ship." Thus, it is shown that if the draught be increased proportionately to the increase of the other dimensions, the cargo can be carried at a steadily decreasing cost as the size increases. The obvious moral of this is that considerations of economy point to the provision of an ample depth of water in and approaching the great shipping ports of the world.

A further explanation of the great economy realized by big ships is found in the fact that a given amount of cargo will be transported in a smaller number of voyages, thereby greatly decreasing docking and other charges. A comparison of the first "Oceanic" of the White Star Company in 1871 with the "Celtic" of 1901, shows that the first boat was 420 feet long, 41 feet beam, and 31 feet deep, with a tonnage of 3,707, Her average speed was 14 knots, and she consumed about 65 tons of coal a day. The "Celtic" has a tonnage of 20,800 on her draught of 39 feet 6 inches, and at her maximum power she will steam 17 knots on a consumption of 260 tons of coal a day. Her speed is about 25 per cent better than that of the earlier boat, and it is estimated that she could carry about four of the first "Oceanic's" cargoes at the cost of one such cargo when carried in the older ship.

The question arises, if the economic inducements for the construction of mammoth vessels are so great, what is the limit to the possibilities of size? The answer is that the limit is determined purely by the harbor accommodations, and that if terminal facilities in the way of 50 to 60 foot channels and 1,500-foot docks were provided we should probably see vessels of double the size of the "Celtic" plying across the Atlantic. If any reservation is to be made in the above statement, it must be on the score of loading and unloading facilities; for the managers of the great steamship lines are already complaining of the extreme difficulty of getting the vast cargoes aboard of these ships in the limited time available between arrivals and departures.

HUMIDITY AND HEATING SYSTEMS.

Under the title of "School Room Temperature and Humidity," a valuable paper was recently read before the Department of School Administration, Detroit, by Mr. William George Bruce, which we strongly recommend to the attention of the directors of our public schools. The paper is too lengthy for the columns of the SCIENTIFIC AMERICAN, and will be found in full in the current issue of the SUPPLEMENT. It draws attention to the fact that there is in the management of school houses a tendency to confound the question of temperature-regulation with that of ventilation. While most school officials, if asked point-blank to define the difference between the two, would probably give a correct answer, it is a fact that they are thoughtlessly confused in practice. It is one thing to provide a class room constantly with fresh air; it is an entirely different thing to so regulate that air that it shall be neither too warm nor too cool. Temperature-regulation in school rooms should be a simple proposition. If the outside temperature is 50 deg. and the school temperature should be 70 deg., only 20 deg. of artificial heat is required to render the school room comfortable. Therefore, the fuel expenditure should be sufficient to cover 20 deg. only, and if it comes above this, it is merely waste and extravagance. An open window to cool off an overheated room is an unwarranted exposure of the children; and yet it is a constant occurrence, we venture to say, in most school rooms throughout the country. While, theoretically, the fuel expenditure should cover only the difference between the outdoor and indoor temperature, it is certain that the most attentive janitor will be incapable of so accurately regulating his fire as to maintain without any variation the desired temperature. In the forenoon the outdoor temperature may be 40 deg., and in the afternoon 50 deg., and though the janitor may anticipate the change in temperature, the chances are that he will not. The solution of the above problem will be found in some well-adjusted mechanical device that will regulate the temperature from hour to hour without any manual assistance.

Perhaps the most valuable hints conveyed in this paper occur where the author treats of the subject of atmospheric humidity, or air moisture, in relation to indoor heating. This is an element in the problem of artificial heating which has never received the measure of attention which its importance demands. It is a well-established, though too little known, fact that the degree of heat which is necessary for comfort indoors is directly related to the percentage of humidity of the air. We who live in New York know by