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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 bitter experience that a summer temperature which is comfortable when the percentage of humidity is low, becomes insufferable when that percentage is high. This is explained by the fact that when the air is dry, evaporation from the body is rapid, and the latent heat of evaporation, being drawn from the body, cools it off proportionately. When the atmospheric humidity is high, the air is less able to receive fresh moisture, evaporation from the body is slow, and its temperature is correspondingly high. Applying this to the low temperature of the winter season, we find that the very dry air of many houses conduces to a rapid evaporation from the human body, and a corresponding lowering of its temperature. Hence the interior of a house in which the air is abnormally dry must be at a higher temperature to be comfortable than an interior in which the percentage of humidity is high.

Speaking upon this question, Dr. W. M. Wilson, of the United States Weather Bureau, who has given the subject careful study, says: "It is safe to assume that during the winter months the normal relative humidity in lake cities is 72 per cent. From observations with respect to moisture in business offices and living rooms heated by steam, hot water and hot air, it is safe to assume that the average relative humidity in artificially heated dwellings and offices in the winter months is about 30 per cent, or about 42 per cent less than the average outside humidity, and drier than the driest climate known."

As the evaporative power of the air at a relative humidity of 30 deg. is very great, the tissues and delicate membranes of the respiratory tract are subjected to a drying process and a great increase of work is placed upon the mucous glands in the effort to compensate for the lack of moisture in the air. This increase of activity, and the frequent unnatural stimulation induced by the changing conditions of humidity from the moisture-laden air outside to the dry temperature inside of our dwellings, result in an enlargement of the gland tissues and a thickening of the membrane itself. It is only a question of time when the surface is prepared for the reception of germs of disease which tend to develop under exposure to the constantly changing conditions referred to. It has been stated by engineers who have given careful study to the subject that by holding the temperature of our school rooms, living rooms and offices at 60 deg. and raising the humidity to 70 per cent, about 25 per cent of the cost of heating might be saved. It is suggested by Dr. Wilson that to avoid the possibility of unpleasant results from condensation, our dwellings could be heated to 65 deg. with a relative humidity of 50 per cent and a saving of from 12½ to 15 per cent secured over the present cost of heating.

This interesting paper naturally raises the question as to whether humidity can be brought under proper mechanical control. That is to say, can atmospheric moisture be supplied artificially and accurately to the extent that may be desired? This is a field of research and experimentation in which some good results have been achieved, but which is yet open for considerable improvement. If the public could be brought to understand how intimately the question of humidity is associated with that of temperature in the matter of heating, there would be a demand for artificial control of humidity, which would react with a beneficial effect on the whole of the steam-heating industry.

THE PROPOSED HISTORY OF THE PATENT OFFICE.

The Patent Office of the United States has now been in existence one hundred and eleven years. During that time it has ever been one of the most efficiently conducted branches of the governmental service. Perhaps because it has so admirably met the requirements of the public, and perhaps because it has been protected as far as possible from baneful political influence, the Patent Office is rarely mentioned in the daily press and is, consequently, the one department of our government about which least is known. For the purpose of enlightening the general public on the work which the office has conscientiously performed during its existence, and of placing in the hands of inventors a book which will explain the method of procedure in obtaining patents and which will give such general information as may be valuable, the Commissioner of Patents has authorized the publication of "a complete history of the Patent Office, with useful miscellany." In the Official Gazette a letter has been published inviting all persons to furnish the chief clerk of the office with rare documents, printed articles, or material not readily obtainable that may p.ove of value in compiling the work.

The literary labor of preparing this history for publication has been entrusted by the Commissioner to five principal examiners, the chief of the Issue and Gazette division, and the chief clerk. This publication commission has already outlined the general plan of the history. From information which we have received the work will be a reference book of vast scope.

The historical chapters will begin with a discussion of mediæval royal monopolies and will show how they differ from the present patents. Besides narrating the history of patents in the United States, the work will describe the organization and administration of the Office, discuss the aims and advantages of the present system, compare that system with the methods followed in foreign countries, and briefly analyze our present laws. The commercial benefits to be derived from a well-conducted patent system will likewise form the subject of a chapter which should prove of unusual interest. One of the most important parts of the history will comprise a careful financial study of the value of patented inventions to the country at large. Statistics will be given to show how enormously the national wealth has been increased by the invention of such devices as the trolley, the telephone, the telegraph, the bicycle, Bessemer steel, the cotton gin, the steam engine, fireproof buildings, and labor-saving machinery. Abstracts from the reports of the Bureau of Labor will demonstrate what the patent system has done to cheapen the price of commodities by fostering inventions. Among the miscellaneous matter which will be included may be mentioned the articles on negro, Indian and women inventors; on the inventive genius of various races; and on the relation of environment to invention, as well as studies of certain prolific inventors, and a brief history of some principal arts.

That so ambitious a work, if successfully completed, will prove of inestimable value cannot be doubted. The office has received innumerable calls from legislators for specific reports on various topics, communications from all parts of the world requesting information not readily obtainable, and, indeed, has itself felt the need of a text-book which could be used by the examiners and their assistants. Hitherto it has been almost impossible to obtain accurate information upon certain subjects pertaining to the work of the Patent Office. Official reports, most meager in their details; the "fire issue" of the Official Gazette which bears the date of October 9, 1877; a handful of congressional documents bearing only upon certain points; Campbell's "The Patent System of the United States;" various periodicals, containing scattered articles comprise the entire information on the patent system at present readily available to the public. To issue a work which would exhaustively treat of the origin, development, and present condition of our Patent Office would be a task which no single person could successfully hope to perform. Only by setting all the machinery of the government in motion and by gathering from official as well as private sources the facts which have accumulated in a hundred years is it possible to bring forth a work in which the United States Patent Office of the past and of the present will be adequately described. From the present indications it seems reasonably certain that the history will be ready for distribution at the opening of the St. Louis Exposition of 1903.

WATER-TUBE VS. FIRE-TUBE BOILERS FOR NAVAL USE.

As our engineering readers are aware, recent experiments were instituted by the English government to determine the relative advantages of two types of boilers, fire-tube and water-tube, the test being made with two naval ships of nearly equal powers and displacements in a race of 1,000 miles, more or less, the vessel arriving first being considered the victor. It seems scarcely possible that such a trial as this has the countenance and support of English engineers generally, for it is in no sense conclusive or satisfactory as to the relative values of either type for naval work, being a sort of go-as-you-please contest, depending largely upon extraneous conditions as to the result, wholly unconnected with the boilers or their management. In this particular "race," as it was called, the fire-tube boiler arrived first, but the weather was so bad, by reason of fog, that the vessel it was in might just as easily have been the last.

Speed in a war vessel is, of course, of the first importance to catch enemies who are trying to escape, but there are other qualities equally necessary, and one of these is that the boilers of such vessels shall be able to keep the sea for a long time without needing repairs that cannot be made on board, also that the boilers shall be capable of being brought into full power quickly, and be easily managed during action. No one type combines all these qualifications, and it is not surprising that naval boards are puzzled as to a choice; there is much to be said for both fire-tube and water-tube boilers, but one of the greatest objections to the fire-tube type, as exemplified in the Scotch boiler, so called, is its extreme weight. The shell-plates of these boilers are from one inch and one-quarter to nearly one and one-half inches thick, or about 56 pounds per square foot; as the boilers are about fifteen feet long by the same diameter, it is easy to see that the shells alone are exceedingly heavy. In addition to this the tubes, furnaces and fixtures generally add a great deal more weight. The Scotch boiler is objectionable from the great difference of temperature between the top and bottom of the shell, and is subjected to enormous strains from this cause alone, aside from that of the steam pressure. The combustion chamber at the end, and the circular furnaces as well, give a great deal of trouble, and the fire-tube boiler requires a lot of watching—with modern steam pressures—to keep it up to its work. But the water-tube has troubles of its own also. Although it is lighter for a given power, and a quick steamer and 200 pounds per square inch can be generated from cold water in thirty minutes without injury, while it takes less space than a fire-tube boiler of the same evaporative power, the tubes, both small and large types, are a constant source of anxiety. With anything like fair treatment, however, the water-tube marine boiler does good work, and is capable of long-continued action.

The United States gunboat "Marietta," having water-tube boilers, went around the world, made quick time, and needed no repairs except renewal of a few tubes in her boilers, but naval officers are by no means a unit for their adoption, each type having its partisans. In our own navy we have vessels fitted with both kinds, fire-tube and water-tube boilers, in one ship, for the purpose of instituting comparison side by side, but neither type has been declared wholly unobjectionable, and the probabilities are that the battle of the boilers will be something like that between guns and armor—as much may be said upon one side as the other.

SCIENCE NOTES.

In 1900 in the Punjab, a section of India, where about one-half a million persons die annually, only 893 were killed by snake bites. Their bite is more often inflicted in houses than either in the fields or in the jungle. During the year in question 1,374 wild animals were slaughtered, including 11 tigers, 186 bears, 184 leopards and 99 wolves; 13,272 snakes were killed.

An expedition to Kolynsk, Russia, is being made by Russian scientists in order to bring to St. Petersburg the mammoth which has recently been discovered. It is unique of its kind, its hair, skin and flesh being entirely preserved, and there are remains of undigested food in its stomach.

The Small Art Palace, one of the permanent buildings of the Paris Exposition of 1900, will be used as an Art Museum for the city, and will receive the collections of works of art which are at present scattered in various places, says The Builder. A special architectural gallery will be provided in which drawings and models can be preserved.

An effort is to be made to remove a large red oak tree from the wildest section of Arkansas to Forest Park, St. Louis, for the Louisiana Purchase Exposition. The tree is 160 feet high and 12 feet in diameter at the base. A double tramway will be built from the tree to the river, where it will be floated and towed to St. Louis. It is estimated that this will occupy six months. The tree will be dug up by the roots instead of being cut, and none of its branches will be trimmed, so that it will appear on exhibition just as it now stands in the woods.

Consul-General Hughes writes from Coburg that, according to the German press, fibroleum, a new artificial leather, has just been invented by a Frenchman. It consists of pieces of refuse skins and hides, cut exceedingly small, which are put into a vat filled with an intensely alkaline solution. After the mass has become pulpy, it is taken out of the vat, placed in a specially constructed machine, and after undergoing treatment therein, is again taken out and put through a paper-making machine. The resulting paper-like substance is cut into large sheets, which are laid one upon another, in piles of from 100 to 1,000, and put into a hydraulic press to remove all moisture. The article is strong and pliable, and can be pressed or molded into all kinds of shapes and patterns. It is said to make the best kind of wall paper. Decorators who have used this article speak of it in the highest terms.

Dr. Alvah H. Doty, Health Officer of the Port of New York, has tried some experiments on the extermination of mosquitoes. His operations were confined to the basin in which is the malaria-infected village of Concord, S. I. Four ponds and a marsh were treated with crude oil donated by an oil company. A 100-barrel tank was run on a railroad siding and the oil was allowed to flow into a portable tank of 10 barrels' capacity. The tank was then taken to the scene of operations. Attached to the small tank was a compressed-air cylinder, and a pressure of 20 pounds to the square inch was used. From the valve of the tank ran a 200-foot hose which connected with a float which carried perforated gas pipes, so that the oil could be forced below the surface of the pond. When the pressure was applied the oil and water were thoroughly mixed. The float was drawn back and forth, so that every foot of the water was covered. The oil as it rose to the surface collected at the edges of the pond, thus destroying any matured larvæ. The experiment is watched with the greatest interest.