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LIQUID AIR "SURPLUSAGE."

Now comes Mr. H. Gaylord Wilshire, editor and publisher of the The Philistine, a magazine "devoted to the demolition of preconceived ideas," who tells the Southern California Academy of Sciences that he can scientifically demonstrate the practicability of accomplishing perpetual motion by means of liquid air. Briefly stated, the demonstration is as follows: A given weight of liquid air will theoretically liquefy an equal weight of air without the aid of cooling water. If the resistance to compression of the air be reduced by passing it through cooling water, the liquid air will liquefy its own weight of air, plus an additional weight due to the cooling water. This is a "surplusage," and hence perpetual motion!

In detecting a fallacy it is sometimes as well, even at the risk of reiteration, to get down to first principles. If a given volume of air at atmospheric pressure and temperature be compressed to a smaller volume, it will have a pressure which is the result of its decrease in volume and the increase in its temperature due to its compression. The pressure due to reduction of volume is permanent at a given temperature, but the pressure due to the rise of temperature is transient, and will disappear as the heat of the compressed air radiates into the surrounding atmosphere. That part, then, of the energy expended in the compressor which appears as heat in the compressed air is a positive loss in all engines which make use of either compressed or liquid air as a motive power.

When air is compressed for power purposes, it is necessary to cool it during compression by passing it in a coil through water which is at atmospheric temperature. If it were not so cooled, and were delivered to the storage cylinders carrying all the heat of compression, it would suffer a subsequent fall of pressure which would amount to the same thing as if it were cooled at the compressor, and there would be a great loss of effect due to the heat so withdrawn. Every heat unit carried off in the cooling water of the original compression is a loss that must be charged against the compressed air or the liquid air, as the case may be, in every subsequent operation in which it plays a part; and when liquid air enters the lists in competition with steam, electricity, hydraulic or any other form of power, it starts with this heavy handicap against it.

In the lecture to which we have referred, Mr. Wilshire argues that in a theoretically perfect engine a given weight of liquid air would produce the same weight of compressed air, if both the liquid air cylinder and the compression cylinder were in free contact with the atmosphere. He then supposes the compressed air to be cooled with water during compression, and argues that such cooling would enable the liquid air to compress an additional volume of air, which he called a "surplusage." The fallacy of the argument lies in the fact that the liquid air itself has already been robbed of its own heat of compression, and the application of cooling water to the air which it is now compressing would merely enable it theoretically to produce by compression and expansion in a frictionless engine a weight of air just equal to itself.

There is no "surplusage" except in the exuberance of the lecturer's own imagination, and the cumbersome wit with which he rails at what he is pleased to call the "scientific Gradgrinds," who, be it said, have very effectually pricked the liquid air bubble. Mr. Wilshire's lecture, which is quite unique in its way, will be reviewed in the next issue of the SCIENTIFIC AMERICAN by President Morton, whose recent exposure of the liquid air fallacies has already attracted world-wide attention.

THE REASON WHY.

American master mechanics were the first to appreciate and prove the advantages of building express engines in which the center of the boiler is placed well above the driving wheels; and it is certainly late in the day for an American journal of the pretensions of Engineering News to be in ignorance of the excellent and obvious reasons for this modern practice. In a recent issue our esteemed contemporary, speaking of the new English express engines (illustrations of which appear in our SUPPLEMENT of the 3d inst.), informs its readers that these locomotives "are of a most peculiar appearance, as *in order to clear the crank axles the boiler is pitched so high* (the italics are ours) that its top is level with the roof of the cab, and this necessitates a little, dumpy smokestack which seems to have no relation to the boiler." As a matter of fact, the cranks have nothing whatever to do with the height of the boiler, there being no less than 15 inches clearance between the bottom of the boiler and the connecting rod ends at the highest point of their revolution. Engineering News evidently is not aware of or does not appreciate the fact that it was Mr. Buchanan, late master mechanic of the New York Central Railroad, who first had the courage to place the center of the boiler two feet above the top of a pair of 7-foot driving wheels, in order to allow the use of a boiler barrel that should be larger in diameter than the space between opposite wheels. As tried in No. 999, whose boiler centerline was a fraction less than 9 feet above the rails, the experiment was eminently successful; for not only was a large tube heating surface secured, but the high center of gravity was found to give an engine that was less destructive to track and roadbed. Inside cylinders may be answerable for many troubles, but a high center of gravity is certainly not one of them, any more than is "a little, dumpy smokestack." This last felicitously named deformity we must further inform our contemporary is due to the fact that the shallow loading-gage on English railways will not allow the smokestack to take on more æsthetic proportions. The same defect in appearance (if defect it be) is noticeable in the big Schenectady engines built some six or seven years ago for the New Haven road, which, we believe, is hampered by some bridges and tunnels that are lower than is common in American practice.

The late A. M. Wellington himself was never friendly disposed to inside cylinders, and for the best of mechanical reasons; but to hear them thus maligned is enough surely to disturb the shades of that gifted and ever-to-be-lamented editor.

REPORT OF THE NICARAGUA CANAL COMMISSION.

The present Nicaragua Canal Commission, which was appointed under an Act of Congress of June 4, 1897, and is popularly known as the Walker commission, after Admiral J. G. Walker, retired, U. S. N., has submitted its full report to the President. A preliminary hearing was given last summer with a view to putting Congress in possession of sufficient data to enable it to legislate on the question during its late session; and while in the nature of things it was impossible, in the then incomplete state of the data, for the commission to give accurate information, it was evident that a serious disagreement existed among the members of the commission on certain fundamental questions relating to the feasibility and cost of the undertaking! The most serious divergence of opinion was on the question of cost, the ranking member and most distinguished engineer of the commission putting the possible cost at about $150,000,000; the Admiral placing it at about $125,000,000, and Prof. Haupt declaring that it could be done within $90,000,000.

In the report just presented, Admiral Walker and Prof. Haupt, who at the preliminary hearing were both ardently in favor of the immediate construction of the Nicaragua Canal, have compromised on a sum of $118,113,790 as representing the probable total cost. This is a jump on the part of the professor of over $28,000,000, or an increase of over 30 per cent on his original estimate of $90,000,000. As the latter gentleman has already said in committee, "the question of cost does not carry very much weight in my mind, even if it were $200,000,000," the astounding difference in his two estimates is easily explained. Col. Hains, who has always shown a conservatism becoming the stupendous nature of the undertaking, estimates the final cost as $134,818,308.

The commission was required to examine all routes heretofore proposed that had any merit, and any new routes that appeared to be feasible, so as to be in the position to present an exhaustive report on the entire region of canal possibilities. After mature deliberation the commission has recommended the Childs route from Brito on the Pacific to Lake Nicaragua, and the Lull route from the lake to Greytown on the Atlantic. The Childs survey was made as far back as 1852 by a distinguished canal and railway engineer of that name, and the Lull survey was carried through in 1873 by Commander Lull, U. S. A., who was sent to the isthmus by the government to re-survey the Childs route. All the members of the Walker commission, although at variance as to cost, are agreed in rejecting the unprecedented and perilous features of the Menocal surveys of 1887 to 1890, and returning to the original plans. As modified, these plans call for a single dam with regulating works at each end of the summit level. On the Pacific side the route follows the left bank of the Rio Grande, crosses the Western Divide to the valley of the Lajas, which river is followed to its entrance to Lake Nicaragua. From the lake the route lies in the bed of the San Juan River to near Boca San Carlos, where it leaves the river and follows its left bank in excavation to the San Juanillo, from which point it is cut across the alluvial land to Greytown. For a complete map and illustrations of the Nicaragua country, the reader is referred to articles published in the SCIENTIFIC AMERICAN of February 18, 1899, and the SUPPLEMENT of April 1, 1899. It is stated that the survey, which has been carried out by a strong force of about one hundred engineers, has brought to light more favorable physical conditions than were anticipated, particularly in the upper San Juan River, where the rock excavation is less than was indicated by the preliminary surveys.

No definite action can be taken by Congress at this time, as it must now await the report of a new commission, authorized at the close of the last Congress, which is empowered to investigate not only the Nicaragua but the Panama and any other possible route, and report as to which is the most feasible to construct and operate. It will probably be a couple of years before the final report of this commission can be made the subject of legislation.

BRASSEY'S NAVAL ANNUAL.

The stirring events of our late war have lent a special interest to the annual publications which deal with the development and statistics of the world's navies, and the recently issued volume of Brassey's Naval Annual, the thirteenth of its kind to appear, devotes two lengthy chapters to the Spanish-American war and the United States Navy. The present volume is somewhat larger than its predecessors, the rapid growth of the various navies causing the tables and diagrams of the ships steadily to increase in volume. There are thirteen very good plates from wash drawings of notable battleships and cruisers interspersed through the reading matter, the "Iowa" being chosen from our own navy for reproduction. There are also nine charts and diagrams, seven of which are explanatory of the naval operations of the war. About one hundred pages are given up to tabular lists of all the warships of the world, and these are followed by ninety plates containing plans of practically every important type of warship in the world at the present time. These plans are line drawings, prepared as far as obtainable from working plans, which show only the armor, armament and leading offensive and defensive features of the ships. We take this opportunity of expressing our indebtedness to this portion of the Annual for many of the small diagrams which have accompanied our articles on the navies of the world.

While upon this subject we would suggest that as the plates in the later editions of the Annual (to save space) are being produced in two sizes, full page and half page, it would be better to reduce the older ships to half page size and reserve the full page plates for the later and more important vessels. Thus among the plates of our own navy we find that while the "Texas," which is rated in this Annual as a third class battleship, is allowed a whole page with five drawings, our latest first-class battleships of the "Alabama" and the "Maine" classes are confined to two drawings of half page size. The same thing is noticeable in the British navy, where the old armored cruiser "Imperieuse" occupies as much space as the two cuts representing the powerful modern ships of the "Cressy" and "Formidable" classes.

From the opening review by Lord Brassey and the tables of comparative strength given in a later chapter, we find that Great Britain has 41 battleships built and 16 building, a total of 57, as against 32 built and 4 building for France, and 15 built and 6 building for Russia. The United States have 5 built and 8 building, all but one of which are of the first class; and it is a gratifying fact that we have more first-class battleships built and building than any other power but England. Of these the latter country has 34 building; France, 11; Russia, 10; Italy, 7; Germany, 9; and Japan 6. Of cruisers England has 137 built and building; France, 52; Russia, 28; Italy, 21; Germany, 24; the United States, 20; and Japan 18. Construction of huge battleships and cruisers whose displacement, speed, and fighting qualities steadily increase, goes on apace. If any one is disposed to doubt the necessity for making regular additions to our own navy, we would draw his attention to a statement which has recently issued from the office of Naval Intelligence, Washington, to the effect that the total tonnage of all the vessels now building or authorized for the British navy exceeds the total tonnage of all the war vessels of the United States navy, built and building, by more than 100,000 tons. We commend this statement of the Navy Department to the attention of those Senators who recently delayed for at least another year the modest addition which our last Congress proposed to make to the navy—modest in comparison with the wealth and responsibilities of a nation which is rapidly moving to the leading position among the great commercial nations of the world.

In reading the chapter upon the "Progress of Foreign Navies," one is impressed with the marked decrease in the number of unprotected cruisers which are being built, all the new tonnage being put into