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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.

ACCURACY AND UNIFORMITY IN ELECTRICAL STANDARDS.

The purchase and sale of electricity for power and light are matters of such every-day importance, that to define in clear and unmistakable terms the quantities by which current is measured commercially as well as scientifically would seem a most necessary duty. These quantities depend upon fundamental units, whose definitions must be stated with scientific accuracy and precision. It is for this reason that the International Electrical Conference, which assembled at London on October 12, possesses an interest which transcends that of most learned bodies. While it was not the object of the conference to formulate laws, yet by making certain definite recommendations for the legal definition of the units, and for their practical realization at national and other laboratories, progress was made toward a uniform system of international standards. In electricity, as distinct from weights and measures, there is not only a single and logically evolved system, but a substantial harmony of electrical units and standards among the civilized nations of the world. Scientists and testing bureaus co-operate to achieve accuracy and unanimity in the definition and reproduction of electrical units. Of such accurate definition of the fundamental units there has been a constantly increasing need. As Prof. Warburg, a German delegate to the recent conference, stated, the practical units of current and voltage have been realized with an accuracy that has tripled in the last three years.

With precision of definition and construction of standards comes of course greater uniformity of practice in both science and industry; and the recent conference was called to clear up doubtful questions and to bring about a desired uniformity. It hardly could be expected that recommendations of a novel or radical character could be adopted; yet at the same time, from the general discussion and the resolutions passed, it is apparent that something was accomplished, and that in the future a greater and more general uniformity will ensue. The resolutions of the conference, it must be understood, must be reported to the nations participating, and be duly legalized just as in the case of standards of length and capacity. While the resolutions decided that the magnitude of the fundamental electrical units should be based on the electro-magnetic system of the Centi-meter-Gramme-Second system, and that the ohm, volt, and ampere should be defined in terms of this system, yet, as a system of units representing the above, and sufficiently near to them to be adopted for the purpose of electrical measurements and as a basis for legislation, there was recommended the adoption of the international ohm, the international ampere, and the international volt, which were duly defined.

In discussing the definitions, considerable difference of opinion developed, as was anticipated. Naturally, the ohm was taken as the first primary unit, and it was defined as the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice 14.4521 grammes in mass, of a constant cross sectional area, and of a length of 106.300 centimeters, the resistance to be determined according to precise specifications. A proposition to make the length of the column exactly one meter and correspondingly cut down the mass of the mercury was resisted, on the score that the ohm, like the prototype meter and kilogramme, should be fixed and unvariable and not subject to adjustment, though of course the true standard could be determined from time to time with all possible precision. Despite the opposition of the American delegates, the ampere was taken as the second fundamental unit, and was defined in terms of a mass of silver (0.001118 gramme) deposited in a second, and the volt was defined in terms of the ampere and ohm. A definition of the watt as the unit of power with the value 10,000,000 in terms of the C. G. S. system, or the energy expended per second by an unvarying current of one international ampere under an electric pressure of one international volt, was passed.

Of equal interest were the recommendations for realizing these definitions by giving the specifications for working methods. For the ohm there is the detailed description of the mercury column and its use. For the measurement of current, a current balance is standardized by comparison with a silver voltmeter, or by the use of a Weston normal, or saturated cadmium cell, whose electromotive force had been determined in terms of the international ohm and ampere and of a resistance of known value in ohms; and finally the international volt is to be determined by the difference of potential of a coil or by the use of a Weston cell whose E.M.F., when set up according to specifications, is provisorily accepted as 1.0184 volts.

The conference recommended that the best method of securing future uniformity would be the establishment of an international electrical laboratory independent of any national laboratory or bureau, whose duties would be the keeping and maintenance of the electrical standards, in much the same manner as the International Bureau of Weights and Measures, which with its laboratory at Sevres near Paris has exerted such a valuable influence on science and industry. As the realization of such a proposition would be a diplomatic rather than a scientific undertaking, it was decided to establish immediately a permanent committee of fifteen scientific men, to be appointed by Lord Rayleigh, the president of the conference, to advise as to its organization, and to supervise any new work or matters unfinished by the conference. This committee is also to consider the important question as to whether the powers and functions of the International Conference of Weights and Measures could not be enlarged, so that under its most efficient organization electrical laboratories and investigations could be maintained and administered in preference to founding a new international institution. At the same time, however, it was the opinion of the conference that the proposed permanent committee should be retained as a distinct body, which should meet at different places in succession. The taking over of work on the electrical standards by the Bureau of Weights and Measures, as has been proposed, would be a most excellent measure; for it has been of the greatest usefulness, both to the nations supporting it and to the scientific world in general. In any event, the spirit of international co-operation as regards electrical units and standards has been so manifest in the past, that the measures proposed by the conference without doubt will lead to a greater uniformity, as reflected in the laws and practices of the civilized nations of the world.

THE TACTICAL VALUE OF TORPEDO CRAFT.

The United States navy has under construction four torpedo-boat destroyers of 902 tons full-load displacement, and Congress at its last session provided for ten more vessels of this general type, which will probably be between 1,000 and 1,200 tons full-load displacement. We also have under construction eight submarine boats, ranging in displacement from 274 tons to 500 tons when submerged; and Congress at its last session authorized the building of eight more submarines, at a total outlay of not more than $3,500,-000. These boats will probably have displacements of not less than 400 tons when fully submerged. As can be seen, the "destroyers" and the submarines represent a very material increase to our torpedo craft, and the question is: In the light of experiments and maneuvers abroad, which type, the surface or the underwater boat, is likely to give us the better defensive return for the money expended?

Apart from the unquestionable offensive powers of the torpedo, *per se*, modern developments in the form of turbine propulsion, superheaters, and more accurate gyroscopic gears have added very materially to the range and the directness of travel. As a result, both the 18-inch and the 21-inch torpedoes have much longer effective ranges; the 18-inch being able to run 1,800 yards at a speed of 35 knots, while the 21-inch torpedo is able to cover a distance of 4,000 yards at a speed of from 26 to 27 knots. Searchlights as now installed upon modern naval vessels cannot be safely counted upon to pick up a low-lying torpedo craft at a distance of much over 1,500 yards, and it is therefore plain that the modern torpedo outranges the reach of the searchlight. Surface torpedo boats and destroyers are not exclusively designed for the use of torpedoes. Each of them carries a fairly considerable armament of rapid-fire guns, and it is evident that their torpedoes are essentially instruments of opportunity, and that that opportunity can come chiefly at night, and then under conditions more or less limited.

Extensive experiments conducted abroad have proved the utter impracticability of a successful daylight attack; the torpedo vessels being theoretically destroyed by the rapid-fire guns long before getting within torpedoing range. Accordingly, night attacks have become the object of most serious study, and with some measure of success.

During some recent maneuvers in the British navy, a problem of this sort was set the division commander of a flotilla of torpedo destroyers: A squadron of cruisers and battleships was sent to sea at night, and a division of destroyers, not informed of the whereabouts of the ships, was ordered to hunt them down and to attack them by means of torpedoes with collapsible heads. The torpedo was to be considered properly fired only when it had struck the hull of a designated ship; the captain of each torpedo craft being obliged to name the vessel chosen by him for attack, and to identify his vessel before firing the torpedoes. The net result of this experiment was that the torpedo boats discovered the vessels and were able to make their attack before their presence was observed by the battleships and cruisers, but not a single torpedo struck home, and no commander was able to state which of the enemy he had endeavored to hit. In order to strike a moving target, the torpedo must be so aimed that due allowance shall be made for the enemy's speed and the direction in which he is moving. These two elements in the triangle of fire are hard enough to estimate in broad daylight, and the difficulty is accordingly magnified by darkness, while atmospheric conditions and any dimness of light will make it hard to identify even well-known vessels. The results in the foregoing maneuvers need occasion no surprise, but they do point significantly to the desirability of securing some means of getting within torpedoing distance within the ranges of daylight, when the probabilities of successful attacks give ample reason of being for torpedo vessels. It is thus seen that the surface torpedo boat is practically denied the chance of doing effective service during the daytime, while at night, except under limited conditions, she is a menace to both friends and foe, unless by some rare chance she be able to get safely within striking distance, and then to make sure that her target is the right one. The blinding effect of the searchlight is all too well known, and with a watchful foe so guarded, the opportunities of reaching a moving enemy are few and far between, because her speed and direction of motion can only be guessed at roughly.

The submarine torpedo boat seems to be the logical solution of the problem. Of course, their problem is the same as that of the surface boat, so far as properly calculating the direction in which the torpedo shall be aimed in order to compensate for the rate and direction in which the enemy is moving; but this is capable of solution through the medium of a proper observing instrument or periscope, and, again, this is an optical task which the Italians are said to have successfully accomplished.

Undoubtedly, underwater boats of the future will be divided into two broad classes; those for harbor and coast defense in the more restricted sense of the terms and those for offshore or seagoing purposes; the mission of the latter boats being not only to keep an enemy well to sea and beyond bombarding range of their guns, but also to accompany a battle squadron at a good cruising speed, and constitute its outlying defense when those ships are anchored in an unfortified port or improvised coaling base. Upon the resumption of the squadron's cruise, the submarines will be discharged of their duty of defense, and follow along in the rear of the big ships. Such would be the principal services of the seagoing submersible of displacements ranging from 300 to 600 tons, while the boats for strictly harbor and inshore protection would be craft of 200 tons or less, capable of holding their positions submerged for a maximum period of probably twenty-four hours. The seagoing submersibles would naturally have to have speeds of fully 15 knots an hour upon the surface, and a cruising endurance at a 10-knot clip of quite a thousand miles. This is not calling for anything extraordinary in view of what has already been accomplished.

Reviewing these conditions in the light of the most recent experience abroad, may it not be justly claimed that we would do wiser by adding more to our flotilla of submarine vessels, and making of our destroyers craft of much larger displacement, so that they may properly serve the purpose of "scouts," for which a field of valuable daytime service does exist; making their torpedo equipment of secondary importance, and recognizing their chance of possible usefulness to be that of a remote opportunity?