
THE INTERNATIONAL SYSTEM OF ELECTRIC AND
MAGNETIC UNITS.†

By J. H. Dellinger.

Two electric units, the international ohm and ampère, have been defined in terms of definite standards by international congresses. These standards are maintained by the national standardizing laboratories, and are the basis of all electrical measurements. The units of the various electric and magnetic quantities are derived in practice from these fundamental units by the ordinary equations of electrical theory. Thus a complete and distinct system of electric and magnetic units is in use, based on the international ohm and ampère, the centimetre, and the second. While these international units differ in their derivation from the electrostatic and electromagnetic units, they nevertheless represent very closely the theoretical electromagnetic units. The very slight differences in magnitude between the international and the corresponding electromagnetic units are determined by absolute measurements made from time to time. The electromagnetic units are of much less practical interest than the international units.

One of the reasons why the international system is the most convenient and the most used electrical system is because it is centred around the phenomena of electric current. Electric current is more familiar and of vastly greater practical importance than electrostatic charges or magnetic poles, upon which the other two familiar systems are based. In the international system the magnetic pole is given a subordinate position. Since a free magnetic pole does not exist in Nature and magnetic pole strength does not appear in engineering formulæ, its prominence in the electromagnetic system has not been an advantage of that system. Another fortunate aspect of the international system is the con-

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venience of its dimensional expressions. They are very simple, and directly suggest the ordinary relations of electrical theory and practice. They are, in fact, as helpful in electricity as the usual dimensional expressions in length, mass, and time are in the domain of mechanics. The international electrical system is valuable only in electricity and magnetism, having no utility in mechanics or other parts of physics. It gives dimensions as awkward for the quantities of mechanics as the electromagnetic system gives for electrical quantities, and is, therefore, not of such general application as the systems in which length, mass, and time are fundamental.

The international system furnishes no justification for the use of the word "gauss" as the name for both the unit of induction and the unit of magnetizing force. This double usage is an inconvenience in practice.

New systems of electric and magnetic units have been proposed from time to time, and some of these are now used to a limited extent in certain books and publications. They all involve the definition of new units of certain quantities in such a way as to redistribute the factor 4π in the equations. An attempt to redistribute the 4π 's in an advantageous manner has been called "rationalization" in the literature of the subject. A careful study has been made to determine whether the advantages of these proposed systems are such as to justify the trouble and confusion incident to a general change of units. No such advantage has been found. Of course, no system eliminates the 4π entirely. All of the proposals except Heaviside's involve changing the unit of permeability by a multiple of 4π . While Heaviside's system leaves permeability unchanged, it makes a drastic change in practically every other unit.

A strong reason against a general change of units for the purpose of rationalization is the fact that a rationalized system is obtained merely by using the ampère-turn as the unit of magneto-motive force. Upon writing the equations necessary to make this widely used unit fit in with the other units, the system is found to be as good as, or actually superior to, the various proposed systems in every respect. It is interesting that the units which have undergone the evolution of actual use are not wanting in academic appropriateness.