AT the University of Minnesota promotions to full professorships include: Darrel H. Davis, geography; Wilson D. Wallis, anthropology, and Jacob O. Jones, engineering. Promotions to associate professorships are: William S. Cooper, botany; John H. Van Vleck, physics; George C. Priester, engineering, and George H. Montillon and Lloyd H. Reyerson, chemistry.

PROFESSOR G. VIALE, of the chair of physiology at the University of Sassari, Italy, has been appointed to a similar chair at the University of Buenos Aires.

DR. J. S. DUNKERLY, lecturer in parasitology at the University of Glasgow, has been appointed professor of zoology and director of the museum at the University of Manchester.

DR. A. W. BORTHWICK, formerly lecturer in forest botany at the University of Edinburgh and afterwards serving on the Forestry Commission, has been appointed to the new chair in forestry at the University of Aberdeen.

DISCUSSION

THE MOST PROBABLE VALUE OF CERTAIN BASIC CONSTANTS

THE first volume of the new International Critical Tables (I. C. T.) contains, on page 17, a list of nine so-called basic constants, and on the following page, a list of twenty-one constants derived from the nine basic constants by direct substitution in certain accepted formulas. In other words, each of the twenty-one derived constants is some function of two or more of the basic constants.

Now it sometimes happens that one can measure a certain function of two or more quantities with a greater precision than that attainable in the measurement of each separate quantity. The numerical value of such a function thus constitutes a condition which should be given due weight, in adopting a *system* of values of the separate constants. The constants given in the I. C. T. were adopted early in the year 1923, and it is questionable whether at that time it was possible to devise a thoroughly satisfactory system. The situation is much better at the present time, as will appear from the following discussion. This relates to the values only of e, e/m, h, and c, *i.e.*, those constants which are of direct concern in spectroscopy.

Because of the general acceptance of the values of 4.774×10^{-10} es for the electronic charge, and 2.9986×10^{10} cm sec^{-1} for the velocity of light (as given in the I. C. T.), we shall tentatively assume these to be correct. We may then calculate h from the observed ratio h/e, since this is now the most accurate method for obtaining the value of the Planck constant.

E. O. Lawrence (*Phys. Rev.* 27, 809, 1926) by the method of critical potentials obtains 10.399 (± 0.007) volts for the ionization potential of mercury. From the quantum relation we have

$$h/e = \text{volts} \times 10^{8}/(c^{2} \times \text{cm}^{-1}),$$

and with cm^{-1} = 84,178 for mercury, one obtains

$$h/e = 1.3739 \quad (\pm\ 0.0009) \times 10^{-17} \text{ erg sec es}^{-1},$$

and therefore

$$h = 6.559\ (\pm\ 0.0044) \times 10^{-27} \text{ erg sec.}$$

The indicated error in the voltage and in h/e is the purely experimental error, while that in h is consequently the probable error *exclusive* of the error in e. (Lawrence gives $h/e = 1.3735$, and $h = 6.550$. Even if 1.3735 were correct, the resulting value of h would be 6.557.)

The second method of obtaining h/e is by means of the continuous X-ray spectrum. The most accurate result, by Duane, Palmer and Yeh (Proc. Nat. Acad. Sci. 7, 237, 1921) leads to $h = 6.5562 \pm 0.0050$, where again the indicated error (deduced by the writer) is exclusive of the error in e. But these investigators used 3.028 for the grating constant of calcite, while 3.029 is now considered the best value. (See, for instance, Compton, Beets and De Foe, *Phys. Rev.* 25, 625, 1925.) Making this correction one obtains $h = 6.5586$, in extremely good agreement with the Lawrence value.

The value of h adopted by the I. C. T. is 6.554. This is the value calculated by the writer (*Phys. Rev.* 14, 361, 1919) in a general discussion of the most probable value of this quantity. On the basis of later work the writer (*Nature* 111, 811, 1923) gave 6.557, with a stated probable error of a few units in the last place. (The I. C. T. give 0.001 as the total probable error in h. This is certainly far too small.) The chief source of error, as previously noted (*loc. cit.*), is that in Millikan's value of e (4.774 ± 0.005) since this quantity occurs to some positive power in every determination of h. The above new results for h indicate that the most probable value is now somewhat higher, and upon the basis of all available data, I now judge 6.560 to be a better value, with the probable error as before. This value evidently satisfies the known values of h/e within limits of error.

A well known relation between c, e, e/m, and h, is that given by the Rydberg constant for infinite mass

$$N_{\infty} = (2\pi^{2} \times e^{5})/(h^{3} \times c^{2} \times e/m) \text{ cm}^{-1},$$

where e/m is in em units. Using 109,677.6 cm^{-1} as the most probable value of the Rydberg constant for hydrogen, and assuming $e/m = 1.760 \times 10^{7}$ em for the evaluation of the small corrective term (59.7 cm^{-1}), one obtains $N_\infty = 109{,}737.3 \pm 0.3$ cm^{-1} as the most probable value. (The writer's older value—*Phys. Rev.* 17, 589, 1921—was 109,736.9.) With this new value of N_∞ and the adopted values of h, c, and e, one then obtains $e/m = 1.757 \times 10^7$ em, as the necessary consistent value. (The I. C. T. value is 1.769.)

Now I have suggested (*Nature, loc. cit.*) that the most probable value of e/m is 1.761 ± 0.002, from a study of the complex Zeeman effect, by H. D. Babcock. The apparent discrepancy here is easily removed by a slight alteration in e, which occurs to the fifth power in N_∞. Thus with Babcock's value of e/m, a value of $e = 4.776$ would satisfy the known relation. As a compromise we shall adopt $e/m = 1.760$, giving 4.7755 for e. One thus obtains the following *system* of values for these fundamental constants which not only satisfies the known relations between these quantities, but which will agree also within limits of error with the most probable value of *each* constant, as determined independent of any such relations. These values are

$$e = 4.7755 \times 10^{-10} \text{ es.}$$
$$c = 2.9986 \times 10^{10} \text{ cm sec}^{-1}.$$
$$h = 6.560 \times 10^{-27} \text{ erg sec.}$$
$$e/m = 1.760 \times 10^{7} \text{ em.}$$

Some of the resulting derived constants are

$$h/e = 1.3737 \times 10^{-17} \text{ erg sec es}^{-1}.$$
$$hc/(e \times 10^8) = 4.1191 \times 10^{-15} \text{ volt sec.}$$
$$hc^2/e = 12{,}351 \text{ volt Å.}$$
$$e \times 10^8/(hc^2) = 8096.2 \text{ volt}^{-1} \text{ cm}^{-1},$$

where in each case absolute volts are to be used (one international volt = 1.00043 absolute volts). The above adopted values differ somewhat from those given by the writer in a recent paper to the Physical Society (Mills College, June, 1926). The later discovery of a numerical error has quite changed the situation, and has led now to the adoption of several new values as just given.

In this connection it is interesting to enquire whether any of the previous investigators have made the correction from the international to the absolute volt. If the published voltages are in international volts, then the value of h derived from the h/e ratio should be raised four parts in 10,000, and since voltage enters into most of the accurate determinations of h, it is likely that the most probable value is more nearly 6.562. In this case e must be still higher, or e/m lower, or both.

The values of the fundamental constants given in the I. C. T. lead necessarily to the quoted value $N_\infty = 109{,}300$ cm^{-1}. The tables, however, neglect to state that this value deviates radically from the known experimental value of 109,737, and this latter value does not appear in the first volume of these tables. The writer wishes to emphasize this matter, and to express the hope that no one will use this incorrect value of 109,300.

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IN the preceding article, certain remarks concerning International Critical Tables seem to indicate that Professor Birge has missed the significance of the particular table to which he refers. This suggests that others may do likewise. Also there is some danger that one may acquire from that article an incorrect impression regarding International Critical Tables. For these reasons, a few words of explanation seem desirable.

That table was not intended to furnish information regarding the most probable value of any of the quantities contained in it, but solely to inform the user of International Critical Tables of the bases upon which rest those data which are unaccompanied by a specific statement bearing upon the subject. Consequently, this table appears anonymously, at the beginning of the work, and in a section of which the first paragraph, entitled "Bases of Data contained in I. C. T.," explains the purpose and the limitations of the table. In particular, it is stated; "Although the accepted values were close approximations to the best values at that time available, it was not claimed that they were such best values." The table was prepared at the very beginning of the work upon International Critical Tables and for the purpose of providing the numerous cooperating experts with a common basis to which were to be referred all data except those for which another basis was plainly necessary. The experts were instructed to confer with the editorial office regarding such exceptional cases, and to include in each report an explicit statement regarding each basic datum which differed from the corresponding accepted constant.

In the preparation of that table, any one of three courses might have been followed. (1) That value, which seemed to be esteemed the best by specialists in the field concerned, might have been selected independently for each quantity. Obviously, values so selected would have been more or less inconsistent, one with another, and, consequently, there would have arisen cases in which data reduced on the basis of one would differ from those reduced on the basis of another, although the two sets of data were derived from the same identical observations. This would have been unsatisfactory. (2) An attempt might have been made to set up a system of values which would give the best fit in every case. The establishing of such a system would have been most excellent; probably it could have been done, but it would have necessitated a thorough study of the entire field, and would have unduly delayed the work. (3) A minimum number of those quantities, which, by a fairly general consensus of opinion, are to be considered of a basic character, might have been selected as basic; for each of these, such a value as seemed to accord with the more trustworthy opinions of appropriate specialists might have been selected; and from these, the values of other quantities might have been computed. This procedure gives a self-consistent set of values, and is the one which was followed. The computed values would have accorded with the experimental ones if the computational equations and the values chosen for the basic quantities had been correct; but in certain cases, such as the Rydberg constant, they did not. The failures arose mainly from the fact that the values assigned by the specialists, to the four quantities, c, e, h, e/m, were mutually inconsistent, although generally, each specialist concerned himself with all four. As it happened, the values "accepted" for these four quantities agreed with those advocated at that time by Professor Birge, except in the case of e/m; for that, an appreciably smaller value was accepted. It now appears that the principal error is in that quantity, and that a still smaller value should have been assigned to it. It was in view of the uncertainties in the values of the basic quantities and of the existence of discrepancies between certain of the derived constants and the best experimental determinations of the same constants, that provision was made for permitting a cooperating expert to use another value whenever such a course seemed justified.

In view of the purpose and the setting of this table it seemed unnecessary to append a note giving the most probable value of each of the several quantities, as such values should be sought elsewhere in International Critical Tables.

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Associate Editor,
International Critical Tables

THE NEED OF AN ENLARGED LIST OF BOTANICAL NOMINA CONSERVANDA

In Science for April 16, Dr. Shear and Dr. Clements, under the title, "The Condition and Needs of Systematic Mycology," state that "two great deterrents to students, as well as to general botanists and other plant scientists, are the lack of uniformity and stability in the use of Latin names and the endless subdivision and duplication of genera and species"; they urge that the quickest and simplest method of bringing order out of the present chaos of names is to prepare a list of fungi following general usage.

Such a list seems to be as much needed for the higher plants as for the fungi, and especially for plants of economic and horticultural importance. The Vienna and Bruxelles Congresses adopted a list of genera. A list of genera and species, if it could be formed in some way so as to secure international acceptance, would be for practical purposes an extension of "nomina conservanda," names conserved until revised as a whole.

For the seed-bearing plants the one comprehensive list is the "Index Kewensis," prepared at the suggestion of Charles Darwin. In the original form it was intended to include all published names and to refer synonyms to accepted names. For the genera and families, Bentham and Hooker's "Genera Plantarum" was followed; the specific names were taken according to the "Kew rule," that is, the earliest under the accepted genus. In the successive supplements the plan of evaluating synonyms has been found increasingly impracticable; to list names from all parts of the world and reduce them to a unified system is not at present possible. Thus, the *Index Kewensis* has become more and more a list of names and not a list of plants, a transformation hastened, perhaps, by the adoption of the "Vienna rule" of using the earliest specific name regardless of genus.

In recent years "Standardized Plant Names," limited to horticultural and economic plants, follows in the main Bailey's "Standard Cyclopedia of Horticulture." The practical importance of the names included makes it of general interest; the principle of names "standard until revised" might perhaps serve botanists as well as horticulturists. For botanic gardens a greater uniformity in nomenclature would much simplify their work.

It would seem that certain changes in arrangement of "Standardized Plant Names" would be desirable for possible international support:

(1) An international botanical edition should be in Latin, omitting English names.

(2) Varieties should be omitted, at least at first, with a view to reaching agreement on main lines before trying to decide the innumerable questions as to varieties.

(3) Authorities should be added to the names.

(4) The genera should be arranged under families, with index of genera referring these to the families. Families are now used to some extent in "Standardized Plant Names," under Ferns, Cacti, Grasses, etc. This plan could easily be extended to all names, with the result of making the whole work more readily available to criticism, so as to gradually correlate with the best botanical opinion.

Such a book would be considerably smaller than the present edition.

In a recent article Dr. A. S. Hitchcock (*American Journal of Botany,* XIII, p. 291) comments on the