Reports and Papers of General Sessions

THE WORK OF THE BUREAU OF STANDARDS AND ITS RELATION TO THE AMERICAN PHARMACEUTICAL ASSOCIATION.

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For the first time, I believe, the Department of Commerce has been invited to send delegates to your convention. The hearty appreciation of your invitation, as indicated by its prompt acceptance, places me in the happy position of bringing you Secretary Redfield's greetings and best wishes in your work and to extend to you his offer of hearty coöperation with the American Pharmaceutical Association along any lines within the proper scope of the Department of Commerce, subject, of course, to such limitations as may be imposed by the appropriations granted by Congress.

The work of the Bureau of Standards is, perhaps, more closely allied with your aims than that of any of the other bureaus of the Department of Commerce and I have been assigned to briefly indicate wherein that Bureau might be of service to your organization.

According to your articles of incorporation one of the principal objects you labor for is, "the establishment of uniform standards for the use and guidance of those engaged in the practice of medicine and pharmacy in the United States." *Standardization* is also the basis of all our own activities. The Bureau, which I have the honor to represent, is in fact a national standardizing and research institution, research being essential for arriving at a proper solution of practically every problem presented.

To briefly indicate the scope of our work, I might say that standards of weight or measure are involved in practically every commercial transaction. One of our functions is therefore the custody of and maintenance of standards recognized by the Government. (Using the term *standards* in its broadest sense.) Thus we have the more familiar standard of length, mass, capacity, etc. In some cases, standards are primarily defined in terms of the metric standards of length and mass and the unit of time. It is, therefore, necessary in such cases to provide also for the *construction* of standards to the highest accuracy of reproduction, from their definitions as well as for their maintenance and custody after construction. The standards used in the measurement of electrical quantities belong to this class.

It is however not only necessary to provide for the custody, maintenance and the construction of standards, but it is also essential to provide means for putting these standards into actual use. This is accomplished by furnishing the individual states with certain standards used in their weights and measures inspection service, and by providing facilities by which manufacturers of standards and measuring apparatus, municipalities, scientific and industrial standardizing and research lab-

oratories, colleges and universities, and all others interested may have their own standards and measuring apparatus verified and attested thus laying the foundation for general uniformity.

When the Bureau was first organized there was practically no inspection of commercial weights and measures in this country, only a few States and a few of the larger cities were doing anything whatever, and as a consequence false and incorrect weights and measures were the rule rather than the exception. Following the organization of the State weights and measures officials into a national association, which meets annually in Washington, new laws have been drafted and passed by a majority of the States. In the States of Massachusetts and Wisconsin not only are the sealers testing weights and measures used by pharmacists in selling to the public but they are also testing such measuring glassware as cylinders and cone graduates to see whether they are constructed in accordance with specifications. It need only be suggested that every effort should be made to coöperate with the local sealers in their administration of the law. All measuring apparatus sold should be correctly graduated and, where there are specifications adopted by the State in which the sale is made, they should be complied with.

Inasmuch as the specifications heretofore adopted by the States for weights and measures have not been uniform and are not likely to be, the Bureau is seeking authority to officially approve the design and construction of all weighing and measuring apparatus used throughout the United States, subject to requirements of accuracy and limits of tolerance which may reasonably be expected, such approval to be necessary before the apparatus can be sold and after approval such apparatus may be sold anywhere without being subject to State or local regulation.

Among the subjects dealt with by the weights and measures division having a more or less direct interest to your organization, are the following:

1. The relation between the metric units and the U. S. customary units.
2. Standard Density and Volumetric Tables.
3. Specifications for
    (a) Chemical volumetric glassware,
    (b) Prescription graduates,
    (c) Hydrometers,
    (d) Weights,
    (e) Sieves.

These will be briefly discussed in the order given.

The fundamental standards for all weights in the United States whether metric, apothecaries, avoirdupois or troy, is the United States Prototype Kilogram. This standard is made of an alloy of platinum with 10% of iridium which is undoubtedly the best material that has yet been found for standards of mass. This standard was made and certified by the International Bureau of Weights and Measures, which is a bureau maintained by a union of 27 of the leading nations of the world. This insures the agreement of the weights of the countries that depend on this international bureau, especially since arrangements are made for the periodical verification of the fundamental standards. The derivation of the apothecaries, avoirdupois, and troy weights from the kilogram insures the maintenance of the exact relations between the various units.

In a similar way our customary standard of length is derived from the international meter by the relation

$$1 \text{ yard} = \frac{3600}{3937} \text{ meter.}$$

The other relations are similarly fixed and equally definite. There would seem, therefore, to be no good reason why different values should be given by different authorities for such equivalents. In looking over tables of equivalents from various sources, however, it is soon discovered that they are neither correct nor uniform. For example, the relation between the liter and the United States fluid dram is given in a certain publication to nine decimal places and the value given is incorrect in the fourth place. The value given is, no doubt sufficiently exact for most purposes, but it would have been much better to have given the value to only four places. This very common practice of carrying values beyond reasonable limits should be discouraged.

A new edition of the Table of Equivalents published by the Bureau will soon be ready for distribution, and it will be found useful in settling many doubtful cases of this kind.

Standard Density and Volumetric Tables. Probably nowhere in scientific literature is there greater lack of uniformity than in density and volumetric tables. Take for example, alcoholometric tables in common use. The names of Gilpin and Bladgen, Tralles, Gay Lussac, Mendeleeff, Morley, and Squibb are familiar to most of you. The alcohol tables of some of these authorities have been in use for about one hundred and twenty-five years. Since these tables are all different the question naturally arises as to which is most nearly correct. In many publications this question is avoided by publishing them all and thus putting the responsibility of a decision upon the user. This is obviously unsatisfactory. The user is in general in no position to judge their relative value and is as likely to choose the worst as the best. For that reason it would be much better for those in charge of any publication to give only a single table or set of tables for alcohol based on what they consider the most reliable piece of work, and omit all others.

Of the investigations in alcoholometry Mendeleeff's work, carried out about 1865, is unquestionably superior to anything done up to that time and is worthy of all the re-calculation it has been subjected to. Nearly fifty years, however, have elapsed since the work of Mendeleeff, and in that time considerable advance has been made in the refinement of physical and chemical methods. It was thought advisable, therefore, that similar work be done under the best possible modern conditions, and in 1910 the work was undertaken at the Bureau of Standards. This work has now been completed and the results published in the Bulletin of the Bureau and also in a circular of standard density tables. These tables have been adopted by the Bureau and are coming into very general use. We believe that they are superior to any alcoholometric tables ever published and that they should be universally adopted, to the exclusion of all others.

Another case of lack of uniformity in the use of tables is that of the Baumé scale. This is an arbitrary scale supposed to bear a certain relation to specific gravity. In 1881 the question of Baumé scales was studied by Prof. C. F. Chandler of Columbia University, and in a paper read before the National Academy

of Sciences he stated that he had found twenty-three different scales for liquids heavier than water and eleven for liquids lighter than water. It will readily be understood that such an array of tables, all passing under the same name, would inevitably lead to confusion. This confusion, though now reduced to some extent, still exists, as may be seen by consulting recent publications. There has, however, been manifested a decided tendency to discard most of the early so-called Baumé scales and, at the present time, there are in use in this country only only a very limited number but there is still opportunity for further reduction.

In 1903 the Manufacturing Chemists' Association of the United States adopted two definite Baumé scales, one for liquids heavier than water and one for liquids lighter than water. These scales are based on the following relation to specific gravity:—

For liquids heavier than water,

$$(1)\quad \text{Degrees Baumé} = 145 - \frac{145}{\text{Sp. Gr.}\ \frac{60^\circ}{60^\circ} - F}\ *$$

For liquids lighter than air,

$$(2)\quad \text{Degrees Baumé} = \frac{140}{\text{Sp. Gr.}\ \frac{60^\circ}{60^\circ} - F} - 130.$$

When the work of testing hydrometers was undertaken by the Bureau of Standards, the good example that had been set by the Manufacturing Chemists' Association was followed by the Bureau, the same two Baumé scales being adopted. At that time careful inquiry was made and it was learned that all manufacturers of hydrometers in this country were using, or at least thought they were using, the same two scales though it has since developed that a certain manufacturer of hydrometers for the oil trade, is, through an error, still using a different Baumé scale.

In the last edition of the U. S. Dispensatory, are given three tables of liquids heavier than water, and three for liquids lighter than water. Two of these in each case should be omitted.

The third subject I had in mind to discuss, was specifications for various kinds of laboratory apparatus. Volumetric glassware is discussed in detail in Circular No. 9 of the Bureau and need not be considered at length here. I would, however, like to call your attention to two points, namely, the unit of volume and the standard temperature. In all volumetric analysis the unit of volume should be the liter, defined as the volume occupied by a kilogram of pure water at the temperature of its maximum density. For convenience the one-thousandth part of the liter called the millimeter or the cubic centimeter is used for small quantities. It should be clearly understood that this unit of volume called the ml. or the cc. is the one-thousandth part of a liter and not the one-thousandth part of a cubic decimeter. For practical purposes in volumetric analysis the two are equal, but for

* Sp. Gr. 60°/60° F. means the specific gravity at 60° F. in terms of water at 60° F. as unity.

more precise calculations the difference which amounts to approximately .003% should be taken into account.

In regard to the standard temperature, it may be said that there is some question whether 20° C. or 25° C. is preferable. 20° C. has been chosen by the Bureau as being closer to the actual laboratory temperature throughout the year, but it is probable that 25° C. is closer to that of a chemical laboratory under normal working conditions. However, the Bureau advocates the general adoption of 20 degrees as the standard temperature, in the interest of national and international uniformity. In any case the really essential thing is that each piece of volumetric apparatus be marked with its standard temperature. If standardized at 20° and used at 25° or *vice versa*, it is a simple matter to correct from one temperature to the other, whenever the accuracy required makes it necessary.

In regard to prescription graduates, the Bureau is not yet in position to make any definite recommendation, except that uniform specifications should be adopted in the different states. The question has only recently come up for consideration by the Bureau, and by weights and measures officials throughout the country, and is at present in a rather unsettled state. The types of graduates to be approved and the accuracy to be required, are very important questions and will receive careful consideration.

The question of hydrometers, is fairly well covered by Circular No. 16 on the Testing of Hydrometers, and by the hydrometer tables in Circular No. 19. What has been said in regard to standard density tables, applies with equal force to standard hydrometers. One thing may be said as a word of warning to those who may have occasion to use hydrometers; that is, no instrument should be assumed to be correct, unless it has been tested by direct comparison with a certified instrument, or by some other means sufficiently exact for the purpose. It is possible to make hydrometers of surprisingly high accuracy, and certain manufacturers are putting out that kind of instruments, but unless the name of a reliable manufacturer is on the instrument, it should not be depended upon and even then it is much safer to test it.

Sieves:—The fineness of a powder, is usually expressed in terms of the sieve through which the powder will pass, and the fineness of the sieve, is given in the number of meshes to the inch, and by the diameter of the wire of which the sieve cloth is made. It is evident, therefore, that in order for the fineness of a powder to be definitely given in terms of a sieve, both these factors of the sieve must be known.

The diameter of the sieve wire, is usually expressed in terms of its so-called "gauge." Now it so happens that there are several wire gauges in use in this country, and for that reason the statement that the wire of a sieve shall be of a certain gauge, is not sufficient to fix the diameter of the wire.

Two of the most important sieve manufacturers in the country use different wire gauges, and for that reason a No. 36 wire to one of them is by no means a No. 36 wire to the other. That being the case, when the statement is made that a No. 60 powder is one that will pass through a 60 mesh sieve of No. 36 wire the question at once arises as to whether it is intended to mean the 60 mesh sieve of one of these manufacturers or the other. A simpler and more satisfactory method would undoubtedly be to specify the diameter of the wire, instead of any gauge

number. This practice is coming more and more to be followed and thus all ambiguity avoided.

The recent revival of interest in the metric system furnishes another avenue through which the Bureau may coöperate with your association. In the performance of its functions the Bureau is required to study every phase of the weights and measures question; and in common with all who have given this subject deep study and attention, has reached the conclusion that the adoption of the metric system by the United States would be a most important step in the development of its social and commercial progress. The Bureau has neither the time nor the inclination to take the lead in the movement to render the use of this system compulsory throughout the country. However it does not hesitate to express its favorable opinion when occasion requires. It is manifest that, under our form of government, such a change can only be brought about by an expressed public demand which has thus far not been forthcoming. The action in your organization regarding the metric system, is a move in the right direction and will be followed by others. The increasing interest in the metric system, is evidenced by the great and increasing demand for the metric chart published by the Bureau.

The bearing of the work of the Chemical Division of the Bureau, upon that of this Association and its various committees of revision is quite obvious.

Atomic Weights. In the Eighth Revision of the Pharmacopœia, the table of atomic weights based upon hydrogen =1, is in use. Since 1906, all the tables published by the International Committee on Atomic Weights have been based on oxygen = 16; which is now almost universally used. For the sake of uniformity and convenience, no doubt the new international basis will be adopted by your association, even though such a change would involve the revision of a considerable number of tables, and of the factors used throughout the text.

The Bureau is now planning an exhaustive investigation regarding standards for volumetric analysis. Preliminary to such a study, inquiries for opinions and suggestions were addressed to a large number of chemists, including some engaged in pharmaceutical work. The replies were, in practically all cases, favorable to such an investigation, and, at least, three pointed out the specific need of more accurate information regarding methods of testing pharmaceutical products. It is unfortunate that the results of any such work, will not be available for use for the next revision of the Pharmacopœia. We are not now in a position to make any specific recommendations regarding the standardization or use of acidimetric or iodometric solutions. Sufficient work has been done however upon the standardization of permanganate solutions, to warrant our selection of sodium oxalate as a primary standard, which is now sold by the Bureau as a standard sample. For a summary of the information upon this subject, I would refer you to Circular No. 40, on "Sodium Oxalate as a Standard in Volumetric Analysis." We suggest therefore that standardization of permanganate by means of sodium oxalate, be included at least as an alternative method in the forthcoming Pharmacopœia.

Testing of Reagents. Infomation secured at this Bureau and from numerous other sources, has indicated the great need of taking measures to improve the quality of chemical reagents, especially those bearing analysis-labels. No doubt

the same situation exists, at least in some degree, with respect to pharmaceutical preparations. As a necessary preliminary to effective steps in this direction, we hope to make a study of the delicacy and suitability of the tests used to detect or determine the impurities present in such materials. The results of such a study, will no doubt be of considerable value in fixing and maintaining standards of purity for chemicals to be used either for pharmaceutical or analytical purposes.

Our ability to take up the experimental problems outlined depends, however, entirely upon the willingness of the legislative bodies in Congress to provide the ways and means. The work contemplated covers a vast field and calls for the uninterrupted services of a good many chemists of high grade over a good many years. If taken up at all, it is probable that these problems will have to be attacked by degrees and that the progress will be slow. While the Bureau of Standards is preëminently an institution in which researches of this kind might be prosecuted, we are in no position to give guarantees of any kind, since we, obviously, have no independent control of funds for maintaining large researches of the kind in question.

There is a further reason which makes it out of our power to accomplish much along new lines of work for the next two years, and that is our lack of room to accommodate the men who are to do it. However, Congress has only recently authorized the construction of a new building, as large as any now in the Bureau of Standards grounds, which is to be devoted entirely to chemistry and is planned to house over 100 workers instead of the 45 or 50 now employed.

Pharmacists may also be interested in many other lines of work of the Chemical Division, for example the work on methods of rubber analysis. Rubber goods are often sold under guarantees which mean nothing, but if bought under standard specifications and tested in accordance with reliable chemical methods and subjected to proper physical tests, it would result in general satisfaction to the buyer, as well as the druggist who now sells merely on the makers' claims and guarantees.

The Bureau is also actively engaged in investigating the methods of specifying color standards, in the establishment of reliable color standards and in the development of methods of color analysis. The relation of such work to your aims is of course obvious.

In addition the work of the Bureau on Polarimetry might be mentioned. The methods of polarscopic analysis are described in Circular 44. New apparatus has been designed for precision-polarimetry and besides the Bureau has placed on sale sugar of exceptional purity by means of which, instruments may be tested through solutions of known concentration.

The work of the Bureau on Chemical thermometers is too well known to require more than brief mention. Besides it will be dealt with more fully by Mr. C. A. Mayo in a paper before the Section on Practical Pharmacy and Dispensing

One of the great problems that confronts the Bureau of Standards, as well as the Government in general, is that of getting into touch with the people of the country. All the theoretical knowledge and all the splendid equipment of the government, is of little value unless it accomplishes something, and certain of this information and equipment can best accomplish its purpose through the

various mediums of the Government publications, and publicity given to these publications by the organs of Societies such as yours.

Among the publications of the Bureau of interest to members of your association are the following:—

The National Bureau of Standards, (Descriptive Pamphlet).
History of the Standard Weights and Measures of the United States.
Metric Chart.
Metric Pamphlet.
Units of Weight and Measure, (Definitions and Tables of Equivalents).
Circular No. 3, Verification of Standards of Mass.
" 5, Testing of Chemical Thermometers.
" 8, Testing of Thermometers.
" 9, Testing of Volumetric Apparatus.
" 16, Testing of Hydrometers.
" 19, Standard Density and Volumetric Tables.
" 24, List of Publications of Bureau of Standards.
" 38, The Testing of Rubber Goods.
" 40, Sodium Oxalate as a Standard in Volumetric Analysis.
" 44, Polarimetry.
Scientific Paper No. 17,
Scientific Paper No. 92. The Testing of Volumetric Glass Apparatus.
Scientific Paper No. 197. Density and Thermal Expansion of Ethyl Alcohol and its Mixture with Water.

These may be obtained free of charge by application to the Bureau of Standards.

I have perhaps given sufficient examples to bring out the statement made in the beginning, that standardization is to be desired above all else both in the work of this association and in that of the Bureau of Standards. If by working together we can help to bring about that end then our work will not have been in vain.

REPORT OF THE COMMITTEE ON PHYSIOLOGICAL TESTING.

The Members of the American Pharmaceutical Association.

GENTLEMEN: We may briefly report that the following is an epitome of the work that has been published on the subject of Physiological Testing in this country and abroad during the past year:

I. *Ergot.*

Dr. Wm. A. Pearson, Journ. Am. Pharm. Assn., 1913.

The Blood Pressure Method of assay is recommended on the basis of the vaso-constrictor action of active extracts of Ergot. Tracings are shown which apparently correctly indicate the degree of activity by the rise in blood pressure of an anæsthetized dog. The effect on the cock's comb is claimed to be due to this action.

Paul S. Pittenger and Chas. E. Vanderkleed, Journ. A. Ph. A.

These authors suggest the use of the excised guinea pig uterus for assaying Ergot extracts and submit tables to show the parallelism between the uterine and Blood-pressure Methods, and tracings to show the sensitiveness of the method.