one must purge oneself of the very human tendency to look only at the favorable aspects of his work, and be ever on the lookout for self deception (which may be quite unintentional). Next, one should never be content with a conventional experimental method or scientific point of view;—one should be open-minded as to the possibility that the procedure or hypothesis may be incomplete. Each step would be questioned, and each possibility of improvement realized. And then, patience, patience! Only by unremitting, persistent labour can a lasting outcome be reached."

GREGORY P. BAXTER

"STANDARDS" AND THE TEACHING LOAD IN SCIENCES

AMONG the "standards" for our colleges and schools formulated by various standardizing and accrediting agencies is usually to be found one that sets a maximum load for teachers. The unit in which the maximum is expressed is the lecture or recitation period. No standardizing agencies attempt in their formulation of standards to differentiate among the various subjects in estimating the teaching load, but some recognize the appropriateness of such differentiation in the administration of their provisions. A number do, however, attempt in their formulated standards to evaluate laboratory work, teaching of other types or auxiliary teaching services in terms of lecture or recitation periods. The evaluation of laboratory work is of peculiar interest to the scientist. It is the purpose of this paper to call the attention of scientists and educators to the fact that the evaluation of laboratory work when embodied in formal "standards" and in practice under less specific provisions is frequently unfair to the teacher of sciences and constitutes in certain cases a serious obstacle to effective teaching.

It is, of course, recognized that many colleges and schools have their own ideals, their own standards for teaching loads, and their own practices in weighing laboratory work in comparison with other types of instruction. So long as these ideals are not lower, the teaching loads not greater and the practices not less liberal than those approved by the standardizing agencies they may be little affected by the agency standards. But many institutions depend upon these agencies to fix their ideals. Some, at least, consider the teaching load set as the maximum by the standardizing agency to be the normal load for their teachers. It is, consequently, of importance that the standards be arrived at with due regard to facts and that they be administered in the light of actual conditions.

Not long ago a man who holds a professorship in a non-science department of a college was comparing the amount of work required of a student in his own courses with that in courses given in other departments. He inquired as to the number of pages in the text used in a particular course in a science and received in reply indication of what to him, manifestly, appeared a very small number. He completed, as he thought, the demolition of his opponent's position with, "And a lot of these pages are taken up with pictures, aren't they?" It is to be feared that many persons, even in educational work, regard the pictures in our texts as so much "filling," expensive filling, necessitated by the styles set by our publishers but justifying slight attention on the part of the student. It is to be feared that many persons regard laboratory work in much the same light—as merely an expensive, fashionable adjunct to the real work of teaching, not making any great demands on teacher or pupil. Indeed, some may be found maintaining that the laboratory is the recreation ground of the teacher of science and that, far from being paid for services there, he might reasonably be required himself to pay a fee, in lieu, for instance, of dues in the country club. It is true that many scientists, by their devotion to the work in their laboratories, lend a certain apparent justification to this view, but it is fundamentally unsound.

The time and energy required by laboratory work varies with the subject, the size of the class and various other conditions, as is true of other types of instruction. In general it may be said that proper conducting of laboratory work involves, while it is in progress, an expenditure of energy on the part of the instructor at least equivalent to that of conducting a classroom recitation. There is the same necessity for quickly sensing the point of view of student after student and for taking measures for eliciting appropriate reactions. But in the typical recitation the attention of the attentive pupils is centered on a common point of discussion. In the laboratory, on the other hand, each properly attentive student is engaged on his separate study; and the instructor, as he turns from one student to another, must constantly shift his attention from one subjective situation to another, from one experiment, one sample of material, one type of difficulty, to another. Furthermore, laboratory work in schools and the great bulk of collegiate laboratory teaching is elementary in character and involves varied materials and methods, for which a maximum of promptly available information and of skill and energy in teaching is demanded. Outside of the periods of actual conduct of laboratory work, there is involved on the part of the teacher a large

amount of work in planning and in providing essential directions, materials and equipment. Whereas in the larger institutions provision of equipment and materials may be the function of persons specifically employed for such duties, in the smaller institutions the instructor is usually obliged to order, or to collect, and to prepare the materials, to assemble and repair the apparatus and to dispose of these after use. Upon first conducting a laboratory exercise or a laboratory course each hour of actual teaching surely requires as much preparation as an hour devoted to delivery of lectures or conducting of recitations would require. After a lecture has been given, its revision and refreshment *may*, under stress of circumstances, be slighted; but preparation for current laboratory work *must* be made. The laboratory teacher, like his comrade in non-laboratory fields, has papers to correct and grading of students to care for. It may be admitted that laboratory work is not in every course, as concerns its contribution to the teacher's load, equivalent hour for hour with lectures or recitations in every course; but any general assumption that the burden of laboratory teaching is less hour for hour than the burden of teaching of other types is utterly wrong. The knowledge that half pay is given by an institution for such work does not encourage the teacher to give his best to it; nor is it conducive in general to that respect which laboratory work should merit and receive. Laboratory teaching, like teaching of other types, is valuable to the pupil and worth while to the institution in proportion to the character and amount of the teacher's preparation for it, the spirit in which he approaches it and the energy he puts into it. Every encouragement should be given him to make the most of his laboratory opportunities.

In view of these considerations attention may well be given to standards formulated by representative standardizing agencies.[1] In the statement that follows, types of formulation of the relevant standards are mentioned and some indications relative to current administrative practice of a few of the numerous responsible agencies are given. No attempt is made to ascribe credit to the originator of a standard for either its substance or its phraseology.

The American Council on Education has taken the lead in an effort to bring about adoption of common statements of standards for educational institutions of various types. For its standards existing statements have commonly been selected and these have been widely copied with more or less modification. These formulated standards recognize the importance of limiting collegiate teaching schedules and make no distinction between teaching of different types in calculating the teaching load. It is highly desirable that agencies whose principles are lower or in whose administration unwarranted distinctions are made should follow this enlightened leadership in expression of principles and should allow no loopholes of interpretation to justify practices prejudicial to the adequate teaching of sciences.

The oldest of our regional associations, the New England Association of Colleges and Secondary Schools, publishes no standards for either schools or colleges. In 1923 the association adopted "Minimum Requirements for an Acceptable College of Liberal Arts," which may fairly be taken as representing its position. The requirement of interest here is as follows: "The college should arrange the teaching schedules so that the total number of hours of any instructor shall vary according to the subject taught, not exceeding eighteen hours per week, including extension work and work in other institutions." No statement as to the practice followed in evaluating laboratory work under this requirement is available.

The Association of Colleges and Preparatory Schools of the Middle States and Maryland, also, has published no policy regarding the weight given to hours of laboratory work in reckoning the teaching load of members of college faculties. In practice, their classification committee has, within ill-defined limits, accepted two hours of collegiate laboratory work as equivalent to one hour of lecture. Standard 5 for secondary schools of the Middle States and Maryland Association, however, specifically permits reduced weight for laboratory teaching. It states:

> The number of daily periods of classroom instruction for a teacher should not exceed five. . . . In interpreting this standard, a double period of laboratory work or of study-room supervision may be counted as the equivalent of one period of teaching.

(Passing over, as merely incidental to the attempt at conciseness of statement, the contrast between laboratory work and teaching, here implied, it may be remarked that study-room supervision may involve more than merely the presence of a teacher to insure conditions conducive to study on the part of pupils. Much attention may be given to individual needs and difficulties. Such work is a strenuous and exacting type of teaching fully equal to a recitation in its drain upon the teacher. So it is in the laboratory,

[1] Names of the various standardizing agencies—national, regional, state and denominational—and much data bearing on their standards may be found in U. S. Bureau of Education Bulletin (1926), No. 10, "Accredited Higher Institutions," or a subsequent edition of this bulletin. Names and addresses of the officers of various agencies may be found in the educational directory published by the same bureau.

except that no one recognizes the purely disciplinary function as appropriate in conduct of laboratory work.)

The standard of the Association of Colleges and Secondary Schools of the Southern States dealing with this matter in colleges of arts and sciences is as follows:

Standard Number 7. Number of Classroom Hours for Teachers. Teaching schedules exceeding sixteen hours per week per instructor shall be interpreted as endangering educational efficiency. In general, two laboratory hours will be counted as equivalent to one recitation hour.

The relevant portion of the standard referring to secondary schools is as follows:

Article 4. (c) The maximum teaching load of any teacher shall be 750 pupil-periods per week with not more than six daily recitations. The commission will scrutinize with extreme care any school in which instructors teach as many as six daily periods. In interpreting this standard, a double period of laboratory, shop, or two periods of study-room supervision shall be counted as the equivalent of one recitation period.

The standards for secondary schools prescribed by the North Central Association of Colleges and Secondary Schools make no mention of any special treatment of laboratory work in reckoning the teaching load. This association's standard for colleges is as follows:

Standard 6. Faculty-Service. The number of teaching hours of classroom work given by each teacher will vary in different departments. To determine this, the amount of preparation required for the class and the amount of time needed for study to keep abreast of the subject, must be taken into account. Teaching schedules exceeding sixteen recitation hours or their equivalent per week, per instructor, will be interpreted as endangering educational efficiency. Institutions which have teachers whose schedules exceed this number must report the facts annually to the Secretary of the Commission on Institutions of Higher Education.

In interpreting the phrase "or their equivalent," the commission exercises special care to see that equivalents claimed as justifying increased teaching hours are really equivalent. Such a provision properly recognizes the necessity for adjustments on the basis of requirements of different subjects and places upon the institution which may advocate reckoning its laboratory work at a lower rate than lecture or recitation work the responsibility for justifying its stand.

The Northwest Association of Secondary and Higher Schools makes no reference in its standards to weighting of laboratory work, but, in practice, it counts two laboratory hours as equivalent to one class period.

The Catholic Education Association, through its commission on standardization of the department of colleges and secondary schools, accredits colleges only. It sets the usual limit of sixteen hours per week for the teacher's load. Inspectors representing the commission are instructed to reckon one and one half hours of laboratory work as the equivalent of one hour of lecture in estimating the load of the teacher.

Other agencies of classes mentioned, a number of the large universities and most of the state departments of education recognize standards identical in phraseology or in effect with one or another of those mentioned above. The need for keeping the teaching load down to a reasonable point in order to make possible the maintenance of a high standard of scholarship in the teacher and a high grade of performance in his teaching is generally recognized. But, in the formulated standards and current practice of many of these agencies, laboratory teaching is improperly represented as of less value than other modes of instruction. Surely upon none is there greater demand than upon the science teacher if he is to keep abreast of his field, aware of its relations to other fields and in touch with current advances in educational thought and practice and with current improvements in the methods of presentation of his subject. Fascinating opportunities for important contributions to educational procedure await his attention. Even more than in most subjects is it both practical and imperative that the teacher of sciences contribute something to the body of knowledge in his field. Not only for the sake of the contribution itself and for his own development, but for the sake of his pupils these research activities are of importance. No presentation of science can be truly effective without emphasis upon the way in which scientific knowledge is won and no other manner of emphasizing this phase can be so effective as to see the truth appearing as a result of persistent research. Nothing adds such zest to the search as the knowledge that this truth is new truth or a new aspect of truth that the mind of man has not compassed before. Discrimination against the teacher of a science through under-valuation of his services in the laboratory is unjust to the teacher, unfair to his pupils and unfavorable to that development in teaching of sciences which the times demand. It is time that scientists should bring this situation to the attention of standardizing agencies and of school and college authorities in positive fashion and should exercise their influence in such ways as may be necessary to remove the handicap under which no small portion of their number are laboring.

It is suggested that those who are concerned investigate the regulations and practices of the organizations which affect them; report pertinent facts through the scientific periodicals; and, through personal influence and the action of groups of scientific men, induce the standardizing agencies to change the discriminatory standards and practices.

M. A. C.

THE GEOGRAPHICAL DISTRIBUTION OF MEMBERSHIPS IN THE NATIONAL ACADEMY OF SCIENCES

THE geographical distribution of memberships in the National Academy of Sciences is a subject of considerable interest, inasmuch as the memberships may be said to have a relationship to research activities in the physical and biological sciences, including anthropology and psychology. The following assignments of residence are as of date August 1, 1928:

MEMBERSHIPS IN STATES		
New York	47	
Massachusetts	40	
California	36	
Illinois	22	
District of Columbia	21	
Connecticut	17	
Maryland	14	
New Jersey	11[1]	
Wisconsin	9	
Michigan	5	
Pennsylvania	5	
Rhode Island	3	
Missouri	2	
Ohio	2	
Arizona	1	
Colorado	1	(retired)
Iowa	1	
North Carolina	1	
Total	238	

The column in the following table headed *M* contains the numbers of academy members who are professors in the medical schools of their respective universities. In several cases it is uncertain whether professors serving their universities in both the medical schools and the academic colleges thereof should be accredited to the medical schools or to the colleges. Another compiler of the table would quite likely make assignments to column *M* differing a little from mine.

The miscellaneous memberships refer to members who are connected with industrial corporations, or are in private practice as engineers, or are serving in other individual capacities. It has not seemed practicable to accredit them to their respective organizations, because of the variety of conditions represented —employee, employer, and so on. However, it is of profound significance that five academy members are research officers in one great manufacturing corpora-

[1] Including one member temporarily residing in Europe.

MEMBERSHIPS IN UNIVERSITIES AND COLLEGES	*M*
Harvard University	28+7
University of Chicago	13+3
Yale University	15+1
University of California	13+1
Columbia University	13[2]
Johns Hopkins University	4+9
Princeton University	9
Stanford University	9
Cornell University	5+3
University of Wisconsin	8
California Institute of Technology	6
University of Illinois	5
University of Michigan	3+1
University of Pennsylvania	2+2
Brown University	2
Massachusetts Institute of Technology	2
Washington University	0+2
Case School of Applied Science	1
Clark University	1
University of Iowa	1
University of North Carolina	1
Northwestern University	1
University of Pittsburgh	1
Vassar College	1

MEMBERSHIPS IN RESEARCH AND SERVICE INSTITUTIONS	
Carnegie Institution of Washington (including Station for Experimental Evolution, Geophysical Laboratory, Mount Wilson Observatory, and Nutrition Laboratory)	12
Rockefeller Institute for Medical Research	8
Smithsonian Institution (including Bureau of Ethnology and National Museum)	7
U. S. Geological Survey	4
American Museum of Natural History	3[2]
U. S. Bureau of Standards	2
New York Botanical Gardens	2
U. S. Department of Agriculture	1
U. S. Army	1
U. S. Coast and Geodetic Survey	1
Lowell Observatory	1
U. S. Navy	1
Rockefeller Foundation	1
N. Y. State Museum	1
Boyce Thompson Institute for Plant Research	1
Miscellaneous memberships	21

[2] Including two academy members who are assigned to both Columbia University and the American Museum of Natural History.