edged ability of their new leader to direct the development of investigation in fruitful lines, an ability already eminently demonstrated by personal researches. It is a further ground of high hope that he adds to commanding ability and fruitful experience, so large and so true appreciation of the higher function of a state university.

Conscious of my personal partiality, I yet believe that in truth the University of Wisconsin is a leader among its class in this higher field of research. But no university has yet fully entered upon it. Which shall be the first to become predominantly an institution of research? Which shall be the first to fulfill the high destiny of an ideal state university? Citizens of Wisconsin, given the means and the moral support, your new educational chief will lead forward with gigantic strides your beloved institution into this upper and broader field of usefulness. Will the means and the moral support be forthcoming? T. C. CHAMBERLIN.

UNIVERSITY OF CHICAGO.

THE MOSELY EDUCATIONAL COMMISSION. II.

IN most American colleges the arts course occupies four years; in a few only is it possible to graduate in three years. At Harvard College, where the subject of the length of the course has long been under discussion, it has recently been determined to allow students to attain the bachelor of arts degree in three or three and a half years, instead of four years; but owing to the improvement in the courses of instruction it will be possible to require from candidates who obtain the degree in the shorter period evidence of higher scholarship than has been expected of their predecessors at the end of four years. The arts course at the Johns Hopkins University extends over three years; but the standard of matriculation is said to be considerably higher than that maintained by institutions which require a residence of four years. The question whether the professional schools of the universities shall require a degree in arts or science from all candidates for admission is now being much debated. There is clearly a strong desire to raise the standard. This is well expressed in the following passage from the report made by President Eliot, of Harvard, at the close of 1902:

> Since the wise and efficient conduct of American affairs, commercial, industrial and public, depends more and more upon the learned and scientific professions, the universities owe it to the country to provide the best possible preparation for all the professions. This best possible preparation can only be given to young men who up to their twenty-first year have had the advantages of continuous and progressive school and college training.

President Eliot gives the following table showing the proportion in nine universities in which law and medical students holding a preliminary degree stand to all students:

Universities.	Holders of a Preliminary Degree.	Whole Number of Law and Medical Students.	Per Cent. of Holders of a Preliminary Degree.
Harvard	886	1,134	78.1
Columbia	562	1,260	44.6
Pennsylvania	331	928	35.6
Northwestern	220	691	31.8
Michigan	216	1,367	15.8
Yale	119	398	29.9
California	118	269	44.0
Chicago (Med.)	100	325	30.7
Cornell	75	607	12.3

Harvard University "has definitely determined to pursue the policy of requiring for admission to its professional schools a preliminary degree and has already applied this policy in all its professional schools except the dental school. The result has been an improvement in its professional schools striking in proportion to the strength of the contrast between the former students and the present in regard to their previous training."

At the Johns Hopkins University, candidates for the degree of doctor of medicine must be college graduates or must give evidence by examination that they possess attainments indicated by a baccalaureate degree in arts or science. Entering college at eighteen, the student is twenty-one or twenty-two years old on commencing this course of professional study; he is, therefore, at least twenty-five or twenty-six at the conclusion of the medical course. A period of post-graduate instruction at home or abroad is then often entered upon. It is not unlikely that the example set by law and medicine will erelong extend to other professions. The undue length of the course of study thus arranged has naturally attracted attention. Recently President Murray Butler, in particular, has commented on it and has proposed a further curtailment of the course. There are instances of such curtailment already. Thus at Cleveland, Ohio, where the Adelbert College and the Case School of Applied Science exist side by side, each having a complete four years' course, it has been arranged to give a double degree at the end of five years to those who have spent three years in the college and then two years in the school of applied science. President Butler proposes that the B.A. degree given at the end of a two years' prescribed college course shall be made the condition of entry to a professional course. He would give the M.A. degree to those who have followed an arts course during four years.

It is remarkable that a people supposed to be practical, like the Americans, should be prepared to devote so long a period to study. I had many conversations on the subject, in which I expressed my surprise; but I must confess that, as a rule, my friends seemed surprised that I should take up such an attitude. I am almost led to doubt whether, in matters of education, our American cousins may justly be regarded as a practical people. A course of study prolonged to an age bordering on thirty rather than twenty implies a most serious limitation on the period during which the individual exercises independence; it casts an improper burden on parents; and it postpones the age of marriage unduly. This last point especially deserves some consideration. The following table, given by President Eliot in his report, records the number of surviving children of members of six classes graduated from Harvard, from twenty-five to thirty years after graduation:

Class of	Number of A. B.'s.	Number Married.	Number of Children Surviving, 1902
1872.....	114	82	165
1873.....	131	96	181
1874.....	165	124	247
1875.....	141	90	171
1876.....	142	106	212
1877.....	188	136	286
	881	634	1,262

He points out that:

If it be assumed that the surviving children are about one half males, it follows that the six classes have by no means reproduced themselves; that they have, indeed, fallen 28 per cent. short of it. Twenty-eight per cent. of the members of these classes are unmarried; and those who are married have, on the average, only two surviving children; so that the married pairs just reproduce themselves on the average.

It is impossible to overlook the significance of such facts. Again, to quote President Eliot:

The table suggests that the highly-educated part of the American people does not increase the population at all, but, on the contrary, fails to reproduce itself. If many other colleges and universities publish class reports analogous to the Harvard reports a competent statistician might establish from the assembled reports some interesting and important conclusions. It is probable that the regrettable result indicated in the table is due in part to the late postponement of marriage on the part of educated young men, a postponement which the protracted education now prescribed for

men who enter the learned and scientific professions makes almost unavoidable. The young physician, lawyer, engineer or architect is now fortunate if he marries at twenty-eight or twenty-nine; whereas he should have married at twenty-five or twenty-six. To make earlier marriage possible is one of the strong inducements for bringing to an end the school course at seventeen or eighteen, the college course at twenty or twenty-one, and the professional training at twenty-four or twenty-five.

Our blind belief in academic methods of training has, perhaps, led us to overlook yet other all-important reasons for shortening the courses. While at college or technical school the student is not only withdrawn from the world of experience—and that, too, during the most susceptible period of youthful freshness—but is always dominated by teachers; the time is so entirely spent in learning from others that there is no possibility of properly developing either imaginative power or individuality. Therefore, not only is physical power sacrificed, but mental procreative power also—this latter surviving only in the genius; whereas, in reality, if education were of true avail, its one great and chief office should be to call forth and develop whatever spirit of originality, whatever element of genius, may lurk in the mind.

Over-teaching seems to me to be the bane of American schools of every grade, even more than of ours. And there is grave danger, especially in America, that the work of education may be over-organized. Classes are being formed to give special instruction in every section of every subject; in consequence, much time is wasted in doing formally what might be done far more rapidly and effectively informally when occasion requires, under intelligent direction or with the aid of properly written instructions.

It would almost seem that higher education is being given mainly in the interests of those who are to occupy secondary positions. The industrial leaders in America, it is said, are mostly men who have not enjoyed the so-called advantages of a liberal education. They are men with minds unfettered by the traditions which education, as now given, is only too likely to impart, yet trained in the world of experience, possessed of common sense. But there are exceptions which show that training in scientific method may be of advantage: a number of the men now at the head of the metallurgical industries commenced their careers as chemists—not as engineers, be it noted.

The entire system of education, both here and in America, seems to require reconstruction from bottom to top; it would be well, if I may say so, if we could scrap the whole wretched academic show and start afresh, in order that it may be greatly improved in quality and shortened in duration. Two ideals should be kept in view—we should aim at the development of individuality and encourage productivity. If a proper foundation were laid during early years a vast amount of time would be saved later on; if children were taught really to read, if they were thoroughly practised in the rudiments of scientific method, if they were even allowed to remain

> Perplext in faith, but pure in deeds,

there would be little that they could not afterwards accomplish within a reasonable time, because honesty of purpose would prevail among them and they would work with understanding and resist all but necessary guidance. The greater part of the work which is now done—far too late—at college might then be done at school; or, still better, college might be entered with advantage at sixteen. We need to remember that, as Buckle tells us, the acquisition of fresh knowledge is the necessary precursor of every step in social progress, and must itself be preceded by a love of inquiry

and, therefore, by a spirit of doubt. One great reason of failure is that nearly all our teaching is dogmatic. To use Tennyson's words:—

> There lives more faith in honest doubt,
> Believe me, than in half the creeds.

We need to introduce broader and more philosophical conceptions into our educational practise; it is almost impossible to keep pace with the growth of knowledge and absurd to add perpetually to the burden imposed upon the student. Moreover, it is unnecessary. If more attention were paid to teaching principles and their application, less to mere facts, many of the difficulties with which the student's path is now strewn would disappear and he would do effective work; our higher education is unfortunately afflicted with the disease of fact-megalomania; if the meaning of one tenth of the facts we now lay before the student were properly taught, the remaining nine tenths might safely be jettisoned.

As a very large number of American teachers have studied in Germany and the teaching is often based on German models, it is remarkable that the university system should bear so little resemblance to that of Germany. As a rule, far more routine work is done and far less attention is paid to research work than in Germany. At Cornell University, for example, although the course laid down for students of chemistry covers four years, no thesis work is demanded. At the Johns Hopkins University, on the other hand, the graduate student who desires to take the Ph.D. degree follows a course almost precisely similar to the German course; but this comes after a two years' graduate course, which has no equivalent in the German system. Of late years, however, much attention has been given to research work in America; still, it is not yet rated at its proper value and those who are engaged in the work by no means enjoy the esteem they deserve on that account. Professor Richards, of Harvard, for example, a chemist of brilliant originality as well as an extraordinarily exact worker, was not appreciated by his university until after he had been 'called' to Göttingen. Work which has no commercial aim or value is not easily recognized as important. As the spirit of inquiry is the mainspring of progress, its cultivation should be a first charge on the bank of education. Germany has long recognized this to be the case, but neither in the United States nor here does such a conclusion yet meet with acceptance. As the prizes offered by industrial enterprise are most alluring, it is essential that more active measures should be taken to develop the capacity for research, so that a larger supply of competent investigators should be forthcoming. And such men are sorely needed to act as leaders in every grade of education.

Science in the Service of the State.—The most striking illustrations of American organizing ability are to be met with at Washington. So far as I am aware, there is nothing anywhere to compare with the way in which science is being utilized in the service of the state by the U. S. Department of Agriculture, which is located in the capital. The origin and development of this department are sketched in a separate bulletin published in 1898. It was established by an act of congress approved by President Lincoln, May 15, 1862. Up to July 1, 1897, it cost, all told, $26,915,988, or less than $500,000 a year.

The department now comprises the following branches: Office of the secretary, the weather bureau, bureau of animal industry, bureau of plant industry, bureau of forestry, bureau of chemistry, bureau of soils, bureau of statistics, division of entomology, division of biological survey, division of accounts and disbursements, division of publications, office of experimental

stations, office of public road inquiries, library.

Agricultural experiment stations have been established in each state of the union under the Hatch Act of March 2, 1887. Agriculture is also supported by the endowment of agricultural colleges under the Morrill Law of August 30, 1890, out of funds arising from the sale of public lands. A list of the agricultural colleges and experiment stations, together with particulars as to courses of study, etc., is given in a separate bulletin (No. 122) published by the department. The organization of the department in 1903–4, together with a brief statement of the work of each division, is to be found in a special circular (Division of Publications Circular No. 1). Full particulars as to the appropriations for the current year are contained in the act (Public No. 158). A year after its organization its entire force consisted of 29 members, mostly clerks. On July 1, 1902, the staff numbered 3,789, of whom 1,209 were executive officers, clerks and messengers, 2,081 scientific investigators and 499 laborers.*

The Agricultural Department in Washington is not merely an office—it is also a busy hive of research. A large number of laboratories are attached to it, in which investigations are being carried on, bearing, in one way or another, on problems in agriculture. Much research work is also done in the state experiment stations; in the main, however, these serve to bring under the notice of farmers the importance of science to agriculture by demonstrating the value of methods of cultivation, manures, etc. There is no question that the research work done under the auspices of the agricultural department and in the experiment stations is of the very greatest value, and is contributing most materially to the development of agricultural industry. To take only one illustration, whereas, in 1884, the amount of sugar made from sugar beet was only about 300 tons, the beet crop of the past year is estimated to yield 400,000 tons; the amount of sugar made in the United States from the sugar cane being only about 300,000 tons. This extraordinary increase, I believe, is due practically entirely to the influence exercised from Washington. A map showing the regions in which the temperature conditions were favorable to the growth of the sugar beet was first prepared by Dr. Wiley, the head of the bureau of chemistry. Seed was then issued to farmers in various districts, together with directions how it was to be dealt with, and the produce was subsequently examined for sugar; in this way it was determined where the beet could be grown successfully. The advantages to be derived from the cultivation of the crop were also made clear to the farmers. An industry of great importance has in this way been gradually brought into existence; at the same time, farming practise has been vastly improved and land has increased considerably in value owing to its having received proper treatment.

The department is undoubtedly exercising an extraordinary influence on the education of farmers by distributing literature among them and by encouraging and helping them in every possible way; indeed, it is certain that, by one means or another, the American farmer is gradually being led to see that science is indispensable to agriculture.

The work that is being carried on in New York state under the direction of Professor Bailey, the director of the College of Agriculture at Cornell University, Ithaca, may be referred to in further illustration, as

* Since this report was in type I have received summary reports of work done in various bureaus of the department: I owe them to the kindness of their several chiefs. It is impossible now to notice them in this report, but I trust to be able to deal with them specifically elsewhere.

this is now a head center of the nature-study movement. The character of one branch of the work may be best made clear by the reproduction of the following circular letter relating to a reading course for farmers:

To the Editor,

Will you not help us to reach the farming community by inserting the following note? The reading-course described below is provided for the farmer by state appropriation. We want him to receive the fullest possible benefit. Kindly send us a marked copy of the issues containing this notice.—Very truly yours,

S. W. Fletcher,
Supervisor of Farmers' Reading Course.

WINTER EVENINGS ON THE FARM.

The wide-awake farmer is now wondering what he can do in the long winter evenings to aid him in the work of next season. He would like to know more about the things with which he has to do; how he can feed his crops better; how he can make a piece of 'worn out' land fertile once more; how he can get the greatest feeding value from the stock of hay and grain in his barn. Many of these practical questions are in his mind at this time.

We would suggest that one of the best ways of answering them is through the 'Farmers' Reading Course,' conducted by the College of Agriculture of Cornell University. Once each month, from November to March, a short lesson on some practical farm topic is sent to each member. These lessons are written in a plain way, so that any farmer can readily understand. The only expense to the reader is an occasional stamp in reply. Many thousand New York farmers are now enrolled in this reading course. All that is necessary to become a member is to send your name on a postal card to Farmers' Reading Course, Ithaca, N. Y. The state pays for this work, and every one in the state interested in farming has a right to its benefits.

For many years Professor Bailey has been studying the improvement of the grounds of rural schools. Recognizing that the school playgrounds are, as a rule, 'bare, harsh, cheerless, immodest!' he has sought to interest those connected with the schools in making them attractive and has put forward hints for the proper laying out of the grounds. The literature on this subject issued from Cornell is of a most valuable character.

But perhaps the most interesting of the movements going on under Professor Bailey's influence is the formal organization of junior naturalist clubs in schools all over the state. This is under the direction of Mr. John W. Spencer, known as Uncle John, whom I had the privilege and pleasure of meeting. The object of such clubs "is the study of nature to the end that every member thereof shall love the country better and be content to live therein. Each member is expected to tell Uncle John at least once a month by letter or by drawings what he or she has seen or thought on some topic in nature-study suggested by the teacher or by the bureau of nature study." These letters are duly registered and read. On the receipt of the fourth, a badge-pin is sent to be worn as a testimony that the owner is entitled to all the honors due to a young naturalist. At intervals, Uncle John writes a letter to his young friends. These letters are full of charm.

Teachers' leaflets and a 'nature-study monthly' are issued in connection with the enterprise. The number of children enrolled is over 35,000. There can be no doubt that a pioneer work of great importance is being done, on which it will be possible to build in the future. It is not possible now to discuss in any proper way the method of teaching adopted. I desire to say everything in its favor, feeling as I do that the object in view is all important; but I am satisfied that the work lacks depth and that those engaged in it are not yet aware of the extent to which it is possible to introduce exact method into such studies; they need to be more fully acquainted with the practise of scientific method and with the art of discovery. It would be more nearly correct to speak of

the movement as one for the promotion of nature love rather than as nature study. At present it involves far too little real study and concentration of purpose; which is unfortunate, as rural children particularly need training in exactness.

One branch of work initiated in the office of experiment stations at Washington of extreme importance, to which reference should also be made, is that relating to the nutrition of man, which has been carried out in various parts of the states under the supervision of my friend Professor Atwater—a fellow student with me in Germany in years gone by—who initiated the inquiry in 1877. The scope and results of the investigation are described in the report of the director of experiment stations for the year ending June, 1901. Undoubtedly the most important and valuable part of this work has been that done during recent years at the Wesleyan University, Middletown, Conn., where a large respiration chamber has been erected and brought to a remarkable state of perfection by Professors Atwater and Benedict. The installation is a very costly one. It is possible for a man to live within this chamber for days or even weeks and for account to be kept during the whole time, not only of the products of respiration, but also of the amount of heat given out and the oxygen consumed, with a degree of accuracy equal to that with which ordinary analyses are carried out in a laboratory. No better illustration can be given of the amount of thought and care which is now being devoted to investigations of practical importance in the United States. I went specially to Middletown to examine the apparatus and was gratified beyond measure; to see it alone was worth a pilgrimage to America. The investigations which can be carried out with such a chamber are of far-reaching importance and touch very closely on the domain of household economics. It is much to be desired that we, on this side, should be able to do similar work.

The geological survey is also a well-organized department in Washington. The wealth of material at the disposal of American geologists is extraordinary. If opportunity beget supply, we may look to America as the breeding ground of geologists in the future. Besides field work and the attendant office work, the department now carries on scientific research work on geological problems. It has a well-equipped chemical department, at the head of which is Professor Clarke, who a few months ago delivered in Manchester the lecture commemorative of the centenary of Dalton's atomic theory. Much valuable work has been done in this department, which is now quite the seat of authority in mineral analysis, Dr. Hillebrand, the senior member of Professor Clarke's staff, being probably the most accomplished and experienced analyst of the day.

Lastly, it may be mentioned that a bureau of standards has recently been established at Washington to do work on the lines of that done by our standards department, the board of trade and the national physical laboratory, but with a wider outlook than any of these and well provided with funds.

When we consider how uncoordinated our efforts are, how little public appreciation exists of the value of science to the community, it is impossible not to feel envious of what is going on in Washington. It would well repay us to inquire very fully into the causes which have operated to produce a willingness in America to listen to counsel which here passes altogether unheeded. Something must be done to create a public belief in the value of knowledge, which will lead us to coordinate our scattered efforts. So long as our outlook is merely insular the future may appear to afford little promise; but if we consider

the possibilities the empire affords, there is no reason why our outlook should not be as hopeful as that of the United States. The resources at our disposal, the agricultural possibilities within the empire, may well be regarded as boundless; but we need to make ourselves acquainted with them and to take concerted measures to exploit them. To this end, it is all-important to constitute effective central organizations in this country similar to those which exist in the United States.

One other illustration may be given. In New York, on the occasion of our visit to the Museum of Natural History, Professor Bickmore, to whom this magnificent museum owes its origin, favored us with an account of the manner in which material was provided for illustrated free popular lectures delivered at the museum, for the purpose of making the people acquainted with their country and its resources; and he delivered a charming lecture to us in illustration of the work. The lantern slides prepared in the museum are placed on sale, so that they can be used for educational purposes all over the country. The lecture we heard was of a very popular character; it was quite clear, however, that pioneer work of a most useful character was being done. It was impossible not to feel that if the resources of the British Museum were were made known by sound popular lectures and handbooks; if the museum, the ordnance and the geological survey departments and the colonial office were to cooperate with the education department in making known the conditions which prevail throughout our Empire, it would at once be possible to put the teaching of history and geography on a basis of fact and make these subjects eminently attractive. The geological survey exists as a branch of the educational department, but its reports are of technical rather than of educational value; they might well, in part, be so written as to be delightful essays on physical geography suitable for school use, if only a little thought were given to them from this point of view.

It is quite clear that the right spirit is at work in the United States; but the lack of the critical faculty and of depth of purpose, combined with an excessive development of the utilitarian spirit, are serious drawbacks at present and militate against progress in education. Until higher ideals prevail and sober calculation takes the place of a somewhat emotional and superficial consideration of its problems, it will be difficult to introduce reforms. Here our difficulty is to break through academic, conservative traditions and to arouse an interest in education; that in reality it is the most important of all subjects to be seriously considered has never yet been made clear to us either by preacher or by politician—the message awaits delivery and we need more than anything else the man to make it heard.

Henry E. Armstrong.

SCIENTIFIC BOOKS.

The Metric Fallacy, by Frederick A. Halsey, and *The Metric Failure in the Textile Industry,* by Samuel S. Dale. New York, D. Van Nostrand Company. 1904. Pp. 231.

A bill was introduced in congress in 1902 with a view to the general adoption of the metric system of weights and measures in the United States. The committee on coinage, weights and measures secured the views of a number of prominent representatives of different professions, trades and manufacturing interests, the majority of whom favored the bill. A change of such fundamental importance required mature deliberation; and the committee were disposed to allow the fullest opportunity for discussion on the part of opponents as well as advocates. The bill will not be brought to a third reading for some months yet, and congress will not be apt to take any precipitate action.