he trained up as co-workers. Moreover, these would work with him through the vacations. Thus, all last summer, frequently till late at night, one could find, in the old basement laboratory, professors and students immersed in work.

More than once he had attractive calls to the east. Yet, because he felt that on going elsewhere he would have to begin all over again with great loss of time, these calls were refused. Had he known how long he would have to wait for the promised new laboratory; had he known that he was never to work in it: even then, I believe he would have stood by the work he had entered upon here.

In spite of all difficulties he was turning out several papers yearly. This summer he was just able to finish and send to *The Philosophical Magazine* a paper on 'Fizeau's Method in Ether Drift.' This will probably rank with a former paper 'On the Resolution of Light into Circular Components in the Faraday Effect.' In the November number of *The Physical Review* he will have a paper 'On Anomalous Dispersion and Achromatic Systems of Various Types.'

Thus did he work to the very end, 'without haste, yet without rest.' Need it surprise us then that those with him caught his inspiration and that the publications of the department, mostly prepared during vacations, should number some forty or more papers?

When can we Americans learn that 'in universities truly worthy of the name,' place should be made for investigation throughout the year; that those fitted for investigation should be untrammeled, perhaps even encouraged to engage therein. Might it not be better to reserve for vacations solely the command 'thou shalt not investigate'?

But it is something that the laboratory he has done so much to create may be named in his honor; and it is more that the band of devoted workers he had gathered about him will therein have the opportunity, as they have the absorbing purpose, to carry to complete and perfect fruition his pregnant ideas.

Cut short in the beginning of his triumphs he will, nevertheless, be ranked among our physicists along with Gibbs and Rowland.

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EDUCATIONAL PROBLEMS AT YALE UNIVERSITY.[1]

The recent history of our large universities shows the growing importance of providing land for museums and bureaus of research.

A university has to deal with two classes of problems—those which arise out of its relations to its students, and those which arise out of its relations to the general public. Most discussions of university work concern themselves chiefly with the relations of the institution to the student body. We try to arrange a course which shall meet the needs of the students; we organize the work of the professors with the same end in view. Three quarters of the time of the corporation and more than nine tenths of the time of the faculties is occupied with the consideration of problems involving the welfare of the students primarily or exclusively.

But this is not the whole work of a university. It must care for its students in this way; but it must do something far more than this. Its relations to the general public are, I believe, quite as important as its relations to its students. It is something more than a large school or group of schools. Its professors can be occupied with something better than the discussion of student discipline. The noble definition

[1] From the annual report of President Hadley.

of President Wilson, that a university is a place where many are trained to the love of science and letters and a few to their successful pursuit, may, I think, be given a broader application than its author had in mind. A university should be a place which promotes the love of science and letters and the understanding of the liberal arts not only among the few thousands who may happen to be its pupils, but among the many thousands with whom it comes less closely in contact. The work of a university is to maintain standards. It can hardly succeed in that work if it confines its inspiration to the relatively small number who have had the good fortune to live within its walls. It must appeal at once to its smaller constituency within its walls and to its much larger possible constituency without them.

Yale men have always recognized this responsibility and have done a great deal of work for the community. But Yale has taken less credit and less advantage from this than it might wisely have done. The relations of this public work to the university have been unnoticed. Its status here was so far undefined that it has been taken out of our hands the moment it has achieved public recognition. I suppose that Yale University may fairly claim to be a starting point of modern scientific agriculture. Certainly the development of agricultural experiment stations, which have proved so important in revolutionizing the practise of our farmers, and have done so much to increase the productivity of our soil, started from Sheffield Scientific School. This movement has extended all over the world. Its cardinal importance in theory and in practise is everywhere recognized. But nobody gives the credit to Yale. We hear of what Wisconsin does for agriculture; we hear of what half a dozen other universities do. Of Yale, we hear chiefly of what she has failed to do. Why? Simply because this whole important movement was in its initial stages carried on so quietly that its importance never properly impressed itself upon our graduates or upon the public; and those universities reaped the benefit which, seeing the real importance of the work Yale was doing, gave it the recognition which we had withheld.

We are in danger of repeating the same kind of error to-day. We are in danger of ignoring the existence and usefulness of some of the things among us which are most important for our public influence. Whenever a reception is held in the galleries of the Yale Art School many men speak with wonder of the fact that they have neglected for years a means of enjoyment and culture which stood ready to their hand. Scarcely one in ten among the Yale students or graduates knows the extraordinary value and interest of our art collections. If our own students do not realize seriously what we have in the way of art treasures and what we might do with them for our own culture, we can hardly expect the outside public to realize it more fully. Our various scientific collections are somewhat better known than our art collections, both to the students and to the public; but even these fall far short of having the usefulness which they might well attain in stimulating scientific interest among the students and throughout the city.

The means which we can use to bring our work more fully into contact with the public may be grouped under five heads:

1. The natural history collections in the Peabody Museum. Of these the most widely known are the fossil vertebrates originally collected by Professor Marsh. Going out as he did at the time when the fossil beds of the Rocky Mountain region were first opened, Professor Marsh had exceptional opportunities for obtaining

material, and in his own particular line of discovery our museum has ranked as the first in the world. Since Mr. Marsh's death his work has been ably carried on, first by Professor Beecher and now by Professor Schuchert. Both of these gentlemen have done a great deal in making the collections accessible to the public; and they would have done a great deal more had they not been handicapped by lack of funds. For the Peabody Museum has practically no endowment for its support, and is dependent upon the small sums which the university can furnish out of its current income. Of scarcely less attraction to the casual visitor are the mineral collections, under the charge of Professor Dana; while we have important material for study both in zoology and in anthropology. It is exceedingly desirable that these different collections should be better known to the citizens of New Haven and their children. A most important connection between university work and public-school work can be made on this line, which would help to give us our proper place in the educational system of the city. The little which has already been done in bringing high school pupils into the museum is proving valuable, both to the children and to us. It is, I hope, only a beginning; an indication of the possibilities which we have before us when we are ready for more organized cooperation with the schools.

2. In the art school we have two unique collections; the Jarves collection of Italian paintings in the north gallery, and the Trumbull collection of early American paintings in the south gallery. The Jarves collection, apart from its value to the student of art history, has a number of pictures of the very first rank, and has been supplemented by others which Mrs. Derby has placed in our charge—so that we can now show excellent specimens of Botticelli, Correggio and other Italian artists of scarcely inferior prominence. Of even more interest to the general public is our collection of modern pictures, of which the Trumbull collection formed the nucleus. Viewed simply from the standpoint of the student of history, the battle pictures by Colonel Trumbull and the contemporary portraits of Washington, Hamilton and other leaders of the American Revolution, are exactly what a university needs to create the right kind of atmosphere within and the right kind of influence outside. No other American university owns art collections approximating ours in value, if we would but avail ourselves of the advantage which they give us. The failure to do this is not the fault of the art school. This school is doing active work in regular classes and evening classes, public lectures and loan exhibitions. It renders us more public service than we appreciate; and it only needs proper recognition in order to make that service many times greater than it is at present.

3. The public work of our music school is somewhat better known. Indeed, this department of the university may serve as an example of what can be done in the way of public service with somewhat small materials, provided men like Professor Parker and Professor Sanford are in charge. With relatively small means at command this school has developed a symphony orchestra which serves at once as a laboratory for the students of music and a means of enjoyment and education to the public. It has repeatedly brought audiences of three thousand people to Woolsey Hall to hear music of the very highest class. Besides these concerts of our own, we have the benefit of visits by great artists from outside; and, what is perhaps still more remarkable, all this part of our university activity has been placed on a self-supporting basis. It has at the same time stimulated an increased interest in the study of

oratorios and choruses among the people of New Haven, under the leadership of various members of our musical faculty. Nor should we fail to mention the importance of the collections given by Mr. Steinert, now housed in the upper floor of Memorial Hall, whose historic importance is parallel to those in our art galleries and museums.

4. Still another development of outside activity is seen in our public lecture courses. These are by no means a new thing. Almost from its very beginning the Sheffield Scientific School has arranged year by year a course of public lectures on scientific subjects under the title 'Lectures to Mechanics.' A few years ago some of the people in New Haven, of their own initiative, organized a 'New Haven University Extension Center,' and arranged for somewhat similar courses of lectures, covering the fields of literature and art as well as science. The advantage of cooperation between the university and the citizens of New Haven was so obvious that we are now working together instead of separately, and by this combination we can keep the grade of the lectures high and at the same time reach a wider range of hearers than would be otherwise possible.

5. The most recent development of our public activity has been connected with the appointment of Dr. Sneath as professor of the theory and practise of education. Professor Sneath's work consists of three distinct parts. He gives regular instruction in his subject; he takes charge of the newly organized summer school; and he arranges means for closer communication and interchange of ideas between Yale and the teachers in various parts of the country. Of the value of his work as an instructor, both to graduate students and to teachers, it is unnecessary to speak. Of his work in organizing the summer school it will be more appropriate to speak in next year's report, when we have a season behind us, than to attempt to prophesy in advance. It will be sufficient for the moment to say that the prospectus of this summer school, issued as a bulletin of Yale University in February, 1905, is a document which every Yale man may read with satisfaction. But, useful as such a summer school may prove, I regard Professor Sneath's work in communicating with the teachers as having even greater importance. At much sacrifice of time and labor, he has made journeys through different parts of the country, especially in the south; and he has at every stage of his journeyings helped us to bring the effect of our Yale life and Yale standards home to those who can not come to Yale as well as to those who can. He has shown the school men of the country what we are trying to do in such a way as to help us to work together instead of separately.

I have purposely confined attention in this summary to the public activities which we already are in position to exercise, without mentioning those which are merely projected. A word should, however, be said of the plan for a forest museum which is in the mind of Mr. Gifford Pinchot. The Yale Forest School was organized just at a time when the American public was beginning to see the importance of the subject. We have had the good fortune to take the lead in this line of education, so that students come to us from every quarter of the world. Mr. Pinchot feels that it would be possible, by the establishment of a museum in connection with this school, to take the same position before the public as a whole that our courses of instruction have given us in the minds of students and specialists, and to make Yale the center to which the whole world will turn for its record of progress in forestry in the past and its suggestions of possible lines of progress for the future. Mr. Pinchot has already realized so many of his ideals that

we may look forward with confidence to his success in whatever he undertakes. I mention it at this moment as indicating the kind of public work which makes the modern university something more than a mere group of schools and elevates it to its highest possible rank—that of a public servant.

Besides its function in maintaining these public collections and lectures, a university should also be governed by a sense of public obligation in arranging its courses of study.

I have in a previous report spoken of this public duty as affecting the freedom of a university in determining the requirements for admission to its professional schools. However convenient it might be to insist on the possession of a bachelor's degree by all pupils in the schools of law and medicine, I feel that it would be a violation of our duty to these professions to hedge ourselves about by any such artificial limitations. We should make the standard of admission to our law and medical schools higher than it is at present; but we should base it upon qualifications for professional study which we could test by an examination, rather than upon previous residence at an institution entitled to give a bachelor's degree. If a man is really fit to study law or medicine we should encourage him to study law or medicine with us, without making arbitrary restrictions.

Considerations of public duty have an important bearing in determining what we shall require for entrance to our undergraduate courses also.

The whole question of entrance requirements is often discussed as though these were things which the college had a right to fix for itself. This is an error. There is a great difference in this matter between the position of a public institution, such as we think Yale to be, and a purely private one. If a man keeps a private school he can make any rules which he pleases regarding the admission of his pupils. If we think these rules are arbitrary or whimsical we may question their wisdom, but we can never for a moment question his right to make them. The case is different with a public institution. If a place like Yale, honored by the presence of the highest officers of the commonwealth in its corporation, and exempt by law from many of the taxes which are paid by others, should choose to make its rules arbitrary, the public would have a grievance. It would say, and say justly, that Yale had exceeded its rights.

Yale is charged with the public duty of educating a large number of boys who, having reached the age of seventeen or eighteen years, and having acquired the freedom which naturally goes with that age, desire to spend time in the acquisition of general culture and broad points of view before narrowing themselves down to the work of the office or the shop. She will err if she makes her requirements so lax as to encourage the coming of idlers, who will waste their own time and interfere with the seriousness of purpose of their fellows. But she will also err in the opposite direction if for her own convenience she makes those requirements so narrow that hard-working boys in the high schools and academies of different parts of the country can not get the teaching which is needed in order to enable them to enter Yale.

It is wrong to say that whatever Yale requires the schools will furnish. Some schools doubtless will; others will not. If the Yale requirements should get so far out of the line of work furnished by the better kind of high schools in the country that we could not expect to get boys from those schools, we should soon become a local institution. Yale would be a school for boys of one kind of antecedents, instead of for boys of all kinds of antecedents; and as soon as it became a school for boys of one kind of antecedents only, it would lose its

value as a broadening influence to its students and as a factor in the life of the whole nation.

Our policy with regard to entrance requirements is thus governed by two separate considerations: our duty to ourselves of not admitting boys except those who are able to do the kind of work which will be required of them, and our duty to the public of admitting all kinds of boys who can do this, on as equal terms as possible. Our student body must be at once hard working and national.

In order to make ourselves national we admit boys to our undergraduate courses by examination only and not by certificate. We believe that the examination method is fairer to boys who come from distant places. The certificate system is the natural one for a state university, which draws its pupils chiefly from the schools of one locality and can inspect and examine those schools; but if a national university tries to apply this system it gives either an unfair preference to the boys from schools near at hand, or an inadequate test to the boys from remote ones. We believe also that the examination system brings us the kind of boys who can take the best advantage of the opportunities we offer. By refusing to admit on certificate we lose some good boys who are afraid of an examination; but as a rule, the boy who is afraid to stand an examination on a subject where he has been well taught is better fitted for the protection of a small college than the liberty of a large one.

The subjects of our examination must be such as to prove whether the student can or can not pursue our courses to advantage. We must have enough mathematics to test the power of precise thought and enough language to test the power of precise expression. We can not allow other subjects to be substituted for these merely because we believe that it is a good thing to have these other subjects taught in the schools. In this respect our policy has differed radically from that of Harvard. When the question has come up of introducing music or wood-working among the entrance requirements, the question with Harvard has been mainly, How far does the college desire to encourage the teaching of music and of wood-working in our high schools? The question with Yale, on the other hand, has been, Can a student who is deficient in grammar be properly admitted to the college because he knows music? Can a student who is deficient in certain parts of his algebra properly be admitted to the scientific school because he understands wood-working? Every new subject introduced as an alternative to the entrance requirements means not simply that we are ready to cooperate with the schools in teaching that subject, but that we value it sufficiently to be content to get on with less than we formerly required of the things which were once considered essential.

On account of this difference in view Harvard has gone rapidly in the introduction of alternative entrance requirements, while we have gone slowly. Our scientific school has not found that the submission of notebooks and experiments, or the examination which could be given in various forms of descriptive science, could well be made a substitute for mathematical theory. It has indeed encouraged pupils from schools where there were good laboratories to pass a supplementary examination on laboratory practise and has admitted them to advanced sections; but it has insisted that these examinations should be regarded as supplementary to the regular requirements instead of excusing the student therefrom. Our academic department has introduced modern languages as substitutes for ancient languages only when they could be made real substitutes. We accept French instead of Greek only when it is a

real equivalent to Greek. Whatever language a boy presents, we insist that his knowledge of it should be precise. We do not let general information take the place of a knowledge of grammar.

It has been charged by critics of the old system of classical study that Greek has been a college fetich. This certainly has not been the view at Yale. We required Greek in the past not because we worshipped Greek, but because in times past the Greek teachers in the schools were the ones who were best able to insist on certain kinds of training which we thought our students needed. Some schools now have French teachers who can give this same kind of training in French. We are ready to accept the boys from those schools with French instead of Greek. To do this is not a departure from our old principles, but a continuation of it. The majority of French teachers are as yet unable to meet our requirements regarding French. Hence the majority of pupils who try to substitute French for Greek fail. Professor Wright's report shows that it is considered fully as hard to enter Yale without Greek as with it. This proves that the widening of the requirements has not been accompanied by a lowering of the standards.

It is probable that as more teachers of modern languages become acquainted with the requirements of the Yale examination we shall get a larger number of freshmen who prepare in modern languages instead of Greek. But this will not prove that we have changed our standard. It will prove that the schools have changed theirs. By adapting our choice of subjects to the needs of the schools we can make the schools adapt their method of teaching to our needs.

In order to do this we shall probably continue to hold separate examinations instead of joining with other colleges. We recognize the high degree of skill with which the Harvard examinations have been conducted. We recognize also the value of that cooperation between schools and colleges which is exemplified in the management of the Middle States' Examination Board. Under proper restrictions, we can accept some of the results of these examinations in determining the fitness of the pupil to enter Yale. But there is enough difference of purpose between us and Harvard to make a strong argument for those who wish our separate examinations continued —and the demand for their continuance, by the way, comes even more strongly from the schools than it does from the members of our own faculty. The Harvard paper seeks to test knowledge; the Yale paper seeks to test accuracy. The Harvard examination tries to find how well a boy has done his work in school; the Yale examination tries to find how well the boy is going to be able to do his work in college. The Middle States' system is intermediate between the Harvard and the Yale systems in these respects, and it is possible that in the near future we may all come together on this median line. We shall certainly do it whenever the great majority of the secondary school teachers demand it. But the results of the correspondence in the report of the Dean of Yale College indicate that the demand for separate papers is stronger than the demand for one consolidated paper. There is a large number of school teachers who find the accuracy incident to the Yale method of examination a great help in resisting certain evils which the widening of school courses during late years has brought with it.

SCIENTIFIC BOOKS.

Outlines of Industrial Chemistry, A Textbook for Students. By Frank Hall Thorp, Ph.D., Assistant Professor of Industrial Chemistry in the Massachusetts Institute of Technology. Second edition. New York, The Macmillan Co. Price $3.50.