SCIENCE

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TO WHAT EXTENT SHOULD THE UNIVERSITY INVESTIGATOR BE FREED FROM TEACHING?[1]

THERE can be no single, direct answer to this question. The answer depends on the man; on what he is doing or how he is trying to do it. And if the man be really a capable investigator, he will be most competent to answer this question for himself. There is then no collective problem admitting of a single answer. The important element lies in the premise that the university must foster research as an integral part of its work, for its own sake as an institution, and for the good of humanity. It is research which has made universities possible, and they must provide for the continuance of the succession. Again, teaching without research is not university teaching. In this sense, we must give a broad definition to the word 'research.' Teaching from second-hand sources is never good teaching.

It is the duty of the university to discover, to coordinate and to disseminate truth; and with this, to train scholars and workers, and to develop personality and character. In this many-sided work all members of the university should take some part, but this part in the nature of things must be very unequal; not many men excel in all phases of university usefulness. Some rare men are useful in the highest degree—but in one line only. Around those preeminent in the discovery of truth, chairs of investigation may be built up.

[1] Read before the Seventh Annual Conference of the Association of American Universities, held at San Francisco, Berkeley and Palo Alto, California, March 14–17, 1906.

But the man should always come before the chair. It is futile to frame a chair of investigation, and then to seek a man to fill it. In general, the investigator who can not teach at all is subject to some defect of temper or to some deficiency in health.

As the world goes, with men of our breed, the primary value of research is in relation to teaching. 'The real teacher is the man advancing in some direction' (T. H. Morgan). Many sorts of mental effort go by the name of research, and properly so. These range from first-hand study of well-known problems through all phases of case-counting and hair-splitting—the rearrangement of old material and the description of new—up to competent and courageous excursions into unknown realms of thought and observation. Some may go far and bring back rich returns, some go but a little way and bring back new aspects of old surroundings, but all should go somewhere and bring back something. It is not needful that all departments should adopt the same methods in research. I see no reason why Greek literature, for example, should be treated as though it were a branch of histology, and history need not be stated in terms of chemical reactions. It does not make work scientific to make it hard. All fresh work is desirable, all should be encouraged, though to most men, even university men, only the simpler forms of research can ever be possible. A man of no great talent for scientific pioneering may be an effective teacher, but a man whose grasp of facts and principles is wholly second-hand can never be such. However old his conceptions and however often his thoughts have been expressed, he must derive them afresh from nature if he is to make them vital to others. To the extent that he does so, he is engaged in a form of research. It is his instinct for first-hand contact, the joy in dealing with realities, which is essential to the great teacher, and these traits are primarily those of the investigator also. The instinct for research grows with practise. It is never safe to let it die. Hence the importance of continuity in investigation and the need of it for the teacher at all stages of his development. A man capable of research will do something of it wherever he is and whatever his limitations. In Huxley's phrase, it is 'the breath of his nostrils.' With time and appliances he will do more work and better work, but you may know the real university man by the fact that he does some work which is his own, even under the most untoward conditions. He is safe so long as he is growing. A growing man incites growth, but not even mold will grow on a fossil.

The American university is emphatically a teaching university, to borrow the English distinction of schools that teach from schools that examine. Its professors are teachers. They are not primarily examiners, as in the English universities of all classes, nor do they have the freedom from personal responsibility that is often assumed in the universities of Germany. For the rank and file of our university men, teaching is the main function, and investigation receives its first value from the fact that adequate teaching is impossible without it.

In general, the university professor recognizes his double duty, his actual work as a teacher, and his duty as an investigator to become a better teacher. Some teaching in general aids investigation; it clarifies the mind, broadens the view and saves from vagaries. Teaching and investigation in a general way are mutually helpful—if the combination is not carried too far beyond the fatigue point. This varies with different subjects and with different men. When the two conflict, investigation is likely to suffer. Research can be postponed; teaching can not. Too much teach-

ing breeds brain fag, which kills the joy of knowing and doing. Here again the personal equation comes in, and to a larger degree. Some men do their best work gregariously—directing, controlling and stimulating the interest of others. Some can work well only when alone and undisturbed. Some kinds of work demand uninterrupted attention for a period. Some require special visits to libraries, to museums, or to distant lands. All these matters should receive consideration by university authorities. The plan of giving each year, on full pay, absolute freedom to one or two professors engaged in research, the same privilege later to be extended to others, is one which deserves general adoption. This absence should mean a year for work, not for rest, nor travel, nor for writing text-books. The present sabbatical arrangement will serve for these, but the pursuit of science demands something more than half-pay furloughs. The university authorities should consider these things, and so should the competent worker who must be the final judge of his own work and his own needs.

An obstacle in the way of this and various other forms of relief which inure to the gain of the university lies in the need of personal discrimination, to which governing boards are painfully averse. The mediocre worker is with us, as well as the man who can not investigate at all. A form of senatorial courtesy obtains in all university faculties. Without it, team work, or work as a cooperative body of scholars, would be impossible. But this very fact forms an obstacle to the relief of those men who could make the best use of freedom.

Among young men who have done a little work, there is too much conceit of research, and overmuch desire to secure at once its rewards. Research pays its own way and asks no reward. Moreover, overmuch cackling indicates that eggs are really small and few. Not all who talk of research, even in Germany, shall enter the kingdom. Perfunctory work, work done for the purpose of catching the attention of the easily deceived college president, work done to be heard from, all these count for very little. Freedom from teaching might only increase the quantity, making its badness more visible. This fact the Carnegie Institution has served to make plain, in its dealings with some of our callow doctors of philosophy.

Moreover, the real investigator will follow his own bent. The disposition of our young men 'to paddle in the same pool,' to rush toward each new field where something is proposed, is a symptom of incompetence. There are fads in investigation, and while the fad is on, the product is scanty. In general, all fields of research are open alike, and they have always been open. Each excursion into one of them is rewarded according to its deserts. In this quest single-heartedness and broad-mindedness are the elements which count for most. Cleverness, technique, speed, self-confidence, facility, versatility, perfection of method even—all these are matters of equipment of minor importance. Too often novelty in work is unduly exalted. Much which we call method is only the trick of making a very small discovery appear epoch-making through bolstering of bibliography, philosophy and historical criticism.

In general, the investigator will wish to publish his results. The instinct of the teacher impels him to do this. Yet it is true that publication is a very poor test of research. Some men keep their results for years—for many years—holding them until their conclusions are ripened, their suppositions verified. A voluminous bibliog-

raphy does not necessarily mean contribution to knowledge. It does not even imply originality of thought or breadth of observation. It is quality that counts, and a single fact well tested and set in orderly relation may outweigh volumes of argument or theory. Under the stimulus to get into print, very much is now put forth which university men everywhere feel might be better dropped into the waste-basket. This would be its final fate, printed or not, were it not for the demands of blindly conscientious bibliographers. Some twenty years ago I used these words:

> I am well aware that there is a cant of investigation, as of religion and of all other good things. Germany, for example, is full of young men who set forth to investigate, not because they 'are called to explore truth,' but because research is the popular fad, and inroads into new fields the pre-requisite to promotion. And so they burrow into every corner of science, philology, philosophy, and history, and produce pretty results in as automatic fashion as if they were so many excavating machines. Real investigators are born, not made, and this uninspired digging into old roots and 'Urquellen' bears the same relation to the work of the real investigators that the Latin verses of Rugby and Eton bear to Virgil and Horace. Nevertheless, it is true that no second-hand man was ever a great teacher. I very much doubt if any really great investigator was ever a poor teacher. How could he be so? The very presence of Asa Gray was an inspiration to students of botany for years after he had left the class-room. Such a man leaves the stamp of his greatness on every student who comes within the range of his influence.

University authorities must, therefore, not fear to become respecters of persons. They should give time, freedom, appliances, where these things can be used, while refusing them to the man who would thereby merely advertise his own insignificance.

The valuation of research is, at best, a difficult problem. Much of the results of hard labor would be better left unpublished, and the valuations set by the authors will not be recognized by the workers of the future. Spurious research is worse than nothing. The pressure to print something is responsible for much of it; the leisure of fellowships for much more. Only a few men can make use of leisure. Moreover, leisure without adequate salary avails little. The busy man under the pressure of poverty, edits texts, writes cyclopedias, throws out potboilers of every kind available to his profession. This is not research. It may be respectable, but it does not develop originality nor mark progress.

In the American university of to-day we teach too much, too many hours, too much that is not worth while, too much to people who do not care for this teaching. We teach at too low a tension, with too little enthusiasm, too little inspiration, throwing too little responsibility on the students, showing too great patience with those not worthy to accept responsibility. The men we call professors are paid too little, helped too much in their early preparation, promoted too rapidly and above all with too little discrimination. It would be better for our universities if half our teachers were in some other profession—if the best half were the ones who remained. This will not be the case until our present scale of salaries is advanced. There is too much encouragement of 'digs'—men with technical accuracy but without personal force or originality or skill in interpretation of new material. There is too much toleration of volatile versatility and of the methods of the Sunday supplement. In our profession it is too easy to get into line for promotion, while promotion itself ought to carry more pay, more freedom, and with all this far higher responsibilities than those we now demand.

Some large degree of freedom from teaching should, therefore, be accessible to the investigator, and this freedom can only be stated as a principle not reduced to rule

or set forth in terms of hours or percentages. But as teaching is itself dear to most true investigators, there are other lines of freedom still more important than relief from class work. The work that kills is not teaching, but the routine which goes with teaching. When I accepted my present position, Governor Stanford told me that he thought the president of the university should do nothing he could hire some one else to do just as well. The university professor should be placed in just this position. Everything that can be just as well done by some one else should be taken from his shoulders. He should have a stenographer, a reader, an artist, an artisan, a 'Diener,' all the helpers who can save his time and add to the dignity and strength of his work. A certain amount of executive work, even of committee work, he should be glad to retain—for the American university is a corporation whose affairs need constant vigilance on the part of somebody. In the long run, its greatest scholars are its wisest men, and in their hands its control should finally lie. The highest type of investigation demands many of the qualities which make a man successful as an administrator. Moreover, it would be a pity and a misfortune to have academic management fall into the hands of those not in sympathy with the highest functions of the university itself. It is not the business man, but the man of science, the man of learning, who should direct the internal management of the university. Those who do not understand the scholar's business can not properly direct the scholar's activities. It may be a matter of regret to use our scholars for executive purposes, but it will go hard with scholarship if the scholar loses control. It is surely a mistake to suppose that any scholarly gentleman who becomes a professor can train investigators. It is the master's touch which awakens the latent instincts of the student. Only the university man can create the university atmosphere.

It is not well that even the best of university men should be freed from responsibility for the welfare of the university in all its interests. Leisure without responsibility is dangerous to all save the greatest. This the English universities have demonstrated, though they have not acted on their knowledge. The fellows of Oxford and Cambridge are provided with life-stipends that they may devote themselves freely to teaching or to research. Half of these men are doing nothing even remotely connected with scholarship. With many of them, fox-hunting occupies a higher place than philosophy, and the drink from the Pierian spring is replaced by simpler and more familiar beverages.

Among endowed investigators in Europe, it is no uncommon thing for a man to say, 'It is time for me to produce another paper; research is due this year again.' Then the investigator hunts through the museum or the library for some topic which will yield the maximum of pages with the minimum of labor.

I do not think that men have often succeeded in research unless they have rejoiced in such work, unless it is the spontaneous expression of their natural activities. Such joy in production gives no guarantee that the work shall be good, but it gives the basis on which training can be made effective.

I can not agree with those who regard university professorships for research alone as one of the primary essentials of the American university. We should not divide our men into research professors and teaching professors. It is not good for the universities that among its varied helpers we should recognize distinctions of caste, nor should we try to develop one group of professors as higher than another or apart

from it. Professor N. S. Shaler has well said:

I believe that no teacher should be so burdened with instruction that he can not do inquiry to a reasonable extent. If he accepts the office of teacher he must make that work his principal end. He should understand that inquiry is necessary to fit him for teaching.

I think that the effect would be bad of having certain men set aside as inquirers even for a part of their time. It would tend to increase that already painful division of our instructors into men who are alive and men who are dead. A man should look upon research as he does on traveling—something that, if he is a breadwinner, he has to take by the way. Only a blessed few who have the rare combination of money and purpose can devote themselves to it.

In the same vein, Professor James Perrin Smith observes:

One teaches better by example than precept, and every university professor should be an investigator in the work that he teaches. But routine teaching must be done and the setting aside of a certain number of men as a sort of priesthood to do nothing but research will make the burden of teaching fall more heavily on the less favored ones, some of whom may contain the germs of real contributions to science or literature. In this way both the research and the teaching will tend to become poorer.

Dr. John C. Branner says:

I do not think that every one who is interested in or capable of carrying on investigation has, or should be encouraged to believe that he has, some sort of right to a professional position. Every professor (not emeritus) should be required to give an important part of his time to personal instruction or to the supervision and direction of instruction. At the same time, the professor who is not engaged in research of some kind is not a fit person to be a professor, though he may be a valuable man for giving certain kinds of instruction. Such a person should not be promoted beyond a subordinate position.

My final answer to the question before us is this:

The university should recognize the necessity of research to university men and in a much greater degree than is now the case in any American university. It should provide for this in the way of all needed appliances, material, books, clerical help, artists, assistants, leisure and freedom. These needs can not be enumerated categorically, for they must vary with each individual man. Among them should be named provision from some source to ensure adequate publication. The plan of granting regularly to one or more professors each year a research leave of absence or of freedom from all other duties is especially to be commended. Each competent investigator can be trusted to indicate his own needs; the university authorities need concern themselves only as to his competence and their own ability to respond. Leisure without responsibility serves no useful purpose, and adequate pay is necessary to give fruitfulness to leisure or freedom. Men should not be encouraged to undertake research in order to gain professorships. Rather they should gain professorships in order to make research fruitful. A university need not provide for research fellowships or research professorships. If it possesses the man of a thousand who can be best used by such provision, it can build a chair about him and his needs, this chair to be abolished at once when the incumbency shall cease. We should grant freedom from cheap and sterile activity—from reading papers, sharpening knives and copying letters; from superfluous committee meetings and from routine work any subaltern could do just as well; and, above all, from the thousand makeshifts of poverty. This relief is far more needed than relief from teaching.

Once in a generation [says a correspondent], perhaps appears a man whose work is so important that he should be entirely freed from instruction, and as much as possible from administration; Darwin is an illustration. Otherwise, the importance of bringing the men of first and second rate training and working power into contact with receptive pupils is so great as considerably to outweigh the value of any scientific investigations

they might make if left entirely free from teaching—Agassiz is a case in point. Anton de Bary was one of the ablest investigators of his generation (he died in 1887). But all his brilliant work would sooner or later have been accomplished by, not one person, but a considerable number of other people, and as it lay in the then advanced field involving microscopical appliances and technique, the great improvement in modern methods has enabled inferior men to do some of his work better than he did it, and clear up difficulties he left unsolved. His influence, however, as a teacher can not be overestimated. The men who received inspiration and training in his laboratory are among the leaders, and what is better perhaps, are among the sanest influences in botanical work in their generation. Again the pupils of de Bary's pupils are among the best influences of the younger generation.

In his students the work of a great investigator is multiplied a hundred or a thousand fold. To be thus remembered, to live thus in the spirit and methods of the generations in science that follow after us, this is for us, as university teachers, as university investigators, as men who teach through the method of research, the noblest type of fame, the worthiest conception of personal immortality.

In the preparation of this address I sent a circular note to about a hundred leading university men, and I have received a singularly valuable and suggestive series of answers. Most of them agree in a general way with my own views already stated, or more exactly, their agreement has helped me to form my own final opinions with more precision and more confidence. Some of them state recognized principles with novel force, while a few others hold views unlike my own on one or two phases of the question. A few are partially satisfied with present conditions, believing that these matters are self-regulating and that the universities are doing all that can be done under present conditions. A few again place a higher value on the young enthusiast who thinks that he can investigate what he can not teach, and others still are more tolerant towards the man who can teach what he can not investigate. One correspondent places especial emphasis on the value of leisure, even though for a time our university men may not know how to use it. He says:

I think, in general, that the great lack in the American college and university is lack of leisure. The ideal seems to be that of 'keeping busy' both the faculty and the students. More show of activity is thus made, and trustees are better satisfied. I believe, on the contrary, that a certain amount of guaranteed unoccupied time every day should be a distinctive feature of the academic life, both for student and for professor. Of course, if leisure were suddenly granted, we should neither of us know what to do with it and how to use it rightly. But we can't learn how to use leisure aright without having some little leisure to use. Reform might come gradually. America, it would seem, has combined the English way of keeping its instructors occupied all day with the German idea of extending the working year over three quarters or more of the solar year. But the English tutor gets more than six months of the year to himself; and the German professor lives a much more leisurely life than the American professor can do. The consequence is, I think, that both the Englishman and the German are, at their best, better academic men than we American professors can be.

This leisure I should give to everybody, and I believe that the granting of it would in essentials answer your question. But I add this: I do not think that the number of men capable of doing research work is anything like so great as one would gather from the scientific journals (SCIENCE, for instance), or from the general atmosphere of faculties. The tacking-on of a graduate school to the college and the implicit idea that every holder of a chair can direct if he can not himself accomplish research work, I take to be wrong and mischievous in the extreme. In England, as there are among the students pass-men and class-men, with no jealousy or rivalry or thought of superiority or inferiority, so there are among the teachers men who are appointed mainly to teach and men who are appointed to research offices. I think that this division should be drawn in American faculties. It should be frankly recognized that the majority of professors, however excellent their method of instruction and

however wide their knowledge, are not fitted or expected to carry on original investigation.

Now to the definite answer to your question. If under existing circumstances a man is found who is capable of extended research—one who can attract young graduates to him, give and take fruitful ideas with them, found a 'school' of sound scientific inquiry—then I should think that such a man ought to be highly cherished and privileged; that he should be called upon to set his own amount of teaching work. Some teaching, especially to the very beginners in his subject, he would probably always want to do. But he should, in my opinion, be freed from the intermediate work of imparting information to students in the mid-period of their training. That such a man should be required, day in and day out, to give his best hours to the routine of instruction, has always seemed to me to be a bit of sheer folly on the part of university authorities.

I am obliged to append a postscript. It is useless to grant leisure, whether to all alike or to a favored few, unless an adequate salary goes with it. It is pitiful to see men who are able to do new work spend their summers in summer schools, or devote what scanty time they now have to routine work for the press, for cyclopedias, etc. Even the arrangement of the sabbatical year is really farcical for men who have only their professorial income to rely upon: to take it one must either have 'married money' or have written a successful text-book whose sale adds to one's income. If professors engaged in research were relieved from the work of instruction, with no further change made, I am afraid that they would at once begin—most of them—to devote their leisure time to the acquisition of scholarly appurtenances and various comforts of living: I do not think that the output of research work would, at least for some time, materially increase.

But leisure without responsibility rapidly deteriorates, except with the superior man, to whom all things are possible. The fellowship system of Oxford and Cambridge in hundreds of cases has degenerated to simple graft, with the same evil effect on English education that American forms of parasitism have had on our own local politics. The sinecure and the examination paper are the two burdens borne by higher education in Great Britain—evil influences from which the American university is relatively free, though every land has its own troubles. There is, again, a distinction between instruction in a man's own line of work and the so-called routine teaching of elementary facts to boys without interest in them. The doors of our universities ought to swing more freely both ways, and the student who doesn't care for his own education should find a way out more readily than he does now.

A few of my correspondents emphasize the value of research professorships as corrective of the tendency to regard routine work as the whole function of the university. Without going quite so far as some others, one correspondent has the following suggestive words:

> The burdening sense of accountability under which the American professor suffers is to my mind the real danger point of the situation. * * * It is the advancement, even the rehabilitation of the academic career, that is concerned. To render that career an inviting one for the ablest minds, to give the career the recognition—social, financial; in honor and dignity and general esteem—that it should have to serve the intellectual interests of the nation best, is the larger end in which your special problem finds a place. The present status of the professor lacks much that is desirable and possible; and part of his difficulty lies in the interpretation of his duties, and even more in the emphasis of that portion of his activities for which he is most esteemed, most rewarded. At present I should say that his advance in most institutions depends upon his serviceability to the university on committees and in its general administrative business; and next upon his ability to achieve a certain sort of popularity amongst the students. To subordinate these modes of estimating his services to the far more essential traits that give worth to a man's services, decided influences should be set into action. Among them I should attach high value to any emphasis of the value of research as an integral part of a professor's life work, as one of the preeminent considerations that justify his place in the university faculty. Any such recognition seems to me a decided, and at the moment a much needed, step in advancing the academic career; and for this reason my view upon your special problem takes decided and emphatic shape.

I believe that a large measure of elasticity should enter into the definite assignment of duty, that the minimum requirements should be small. We can not accept either the German, French or English view of the situation. We hold a man to a far more rigorous task, leave less to his decision than do any of these foreign institutions. Our professors are more distinctly engaged to teach. Yet it seems to me so hopeless to look for the career of research in many departments of learning outside of the universities, and its presence in the university is so helpful, that the wiser solution seems to me frankly to include the research program within the larger cultural and practical ends for which universities exist, and thus to afford the professors whose interests lie that way the largest possible relief from teaching, to devote themselves to so integral a part of their function as investigation occupies.

This should apply as well to the younger men. The great point that is made in favor of the German 'Docent' system is that it leaves men free at the most energetic periods of their lives to pursue their own interests. They are accountable to no one; have acquired the privileges of teaching, but no duties other than those voluntarily assumed; they are to work out their careers as freely as they like, and frequently are given the facilities that they need. This again we can not do; but I believe it may stand as an emphasis of the influences that our universities can wisely cherish, though they must use other means to express their esteem of this part of the academic career.

I do not see how the practical side of the issue raised can be met by any formula. Having expressed the trend that seems to me to be worth favoring, the actual determination of ways and means involves a series of practical considerations, often of local considerations, that resist formulation. Taking the provisions that the most enlightened of our universities make for research (and they are considerable), I am willing to venture the opinion that these could be distinctly and liberally enlarged without, in my opinion, rendering the universities open to the charge of overemphasizing this portion of their functions, or of failing to interpret properly the functions of the professor and his duties towards the university from which he obtains his support.

Another correspondent attacks one more phase of our difficulty, the waste of our resources through trying to do too many things. He says:

The chief factor in determining from decade to decade the actual course of study in American universities has been, as I think, the pressure of new subjects for recognition. This pressure changed the pressure of seventy-five years ago, with its slender list of subjects, into the curriculum of forty and twenty-five years ago, whose aim was to compress a bit of each sort of learning into a four years' course. When this became impossible, two courses of study were made and then three. The ground must be covered. No one student could cover the ground, but the catalogue must do so.

The same pressure, growing always greater, caused the so-called all-round course of study to blow up from within, leaving its debris in many new and strange forms of educational practise. * * *

Finally, the same pressure which has caused the multiplication of departments has caused the multiplication of specialties within departments. Science has developed such and such new fields of learning. They demand recognition. They are recognized at such and such institutions. We must recognize them here. We must cover the ground. No student can cover the ground, but the university must do so.

If a university were rich enough to cover the whole ground of learning with first-rate introductory courses on the freshman-sophomore level and then to cover the whole ground again on the junior-senior level, with a vast array of electives, and finally to support research in a correspondingly adequate measure, we might say let it be so; let this limitlessly rich university do by itself what it is really the business of all the universities and learned societies combined to do. It is fine to imagine an institution where every science and every art might be studied upon every level, with no lack of money or of men, or of leisure for the men who do productive work. It is not surprising that this splendid conception, which must be the ideal of the university world as a whole, should be more or less consciously the ideal of particular universities. But in point of fact, the whole university world is not at present rich enough for the full realization of this ideal. And when a single university, even the richest, attempts to do everything on every level, the inevitable failure of the undertaking is sure to appear in some way.

The failure does appear very generally in two well-known ways—first, in the cheapening of the elementary collegiate work; and second, in the restriction of productive research work.

It is said that in the American university there is a necessary internal conflict between the collegiate interests and the university interests. My judgment is that in the larger American universities generally, the greatest enemy of both these interests is the excessive expansion of the course of study.

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There are obviously two ways of cutting down the amount of work which the university shall offer. We may cut down the number of departments, or we may cut down the number of courses offered by the several departments.

The first of these methods is radical. It is a grave matter to abolish a university department—not really more grave, I think, than the establishment of a new department whose justification may be doubtful but for many and obvious reasons a procedure which university authorities must hesitate to adopt. Nevertheless, even such radical pruning may be justified. It can become a question between cutting off some large limbs and the languishing of the whole tree. I shall not be surprised if within the next generation the pressure of circumstances should force the universities to the adoption in a considerable degree of this extreme form of selection.

Meanwhile, we have at hand a much gentler and yet scarcely less efficient method of selection if the departments will cut down the amount and range of work offered by them. Let me put this method of reorganizing and concentrating the course of study in the form of definite proposals. Let there be in each principal university department:

1. A fundamental elementary course.

2. A very strictly limited amount of undergraduate work beyond the introductory course.

3. All the rest of the work offered by the department strictly graduate or research work.

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Without affecting the number of majors or of groups or of departments, we may very decidedly reduce the number of undergraduate courses offered. Here, as I think, is the place for the pruning knife. The universities can cover the whole field of learning in typical introductory courses on the freshman-sophomore level. We can not each of us by any possibility cover the ground on all higher levels. We must select. We must reject, right and left, subjects which have every argument in their favor except that we can not do them all. We must weed out the suckers as a condition of having cornstalks.

There would result apparent hardships for the undergraduate and for some members of the faculty. The undergraduate would not be able, on the one hand, to take a large proportion of his college course within one narrow field, thus becoming a specialist without becoming an educated man; and he would not be able on the other hand to browse far and wide over any and every field which modern learning has developed. He would find instead, however, an abundantly wide choice of majors or of groups each offering an austerely chosen list of representative courses arranged so as to make a substantial center for a college course. And this, whether or not he is to become a specialist, is, I believe, the best thing which the university of to-day can offer him.

I have considered in this connection also the possible hardship to the younger professors who want to have each at least a small amount of advanced work to do. I do not wish to slight this consideration, for it is an essential feature of the university life that the younger men should have the door of hope open. I have not solved this problem to my own satisfaction, but I say this: If an instructor can do important productive work, the university should try to offer him as much leisure as the value of his work appears to warrant, whether he is doing the work with students or alone. What the university can not afford to do is to pay so dearly for elementary, non-productive junior and senior work. These courses are the suckers.

3. Productive work. The freshman-sophomore fundamental courses should be the first gainers from the resources of money and leisure saved by cutting off excessive expansion. The second gainers should be the graduate and research courses. I wish to consider this second gain as it might affect the larger universities and then as it might affect the smaller ones.

(*a*) Our greatest universities are very rich. They have great graduate schools. They have scholars who have proved to be productive men. And yet, when the total output of scholarly work done in them is compared with that done in Germany, for example, the result is generally conceded to be discouraging. In many cases, little is accomplished beyond the comparatively elementary research work which has its terminus in the doctor's degree. No explanation of this result seems so probable as the fact that the German professor has, as a rule, the leisure which the American professor only secures by exception. It is doubtful whether the German rule can or should become the American one while we have the college and the university united in one institution. We wish

our greatest scholar to surrender a little of his time to the freshman. But having asked this of him as a duty of religion, we should spare his leisure as the most precious asset of the university. We should count it a sin to require such a man to 'cover the ground.' We should sacrifice the catalogue, make it thin and full of holes, confine the students to a narrow range of typically good choices, and by these inconsequential sacrifices preserve for the great man his chance to do the work which he alone can do.

(*b*) There is an evil suggestion in the air that a university should not attempt to do advanced graduate and research work unless it is very rich. I know of nothing to justify such a counsel of discouragement. The history of learning, the history of the little universities of Europe, the current history of scholarly work in America, all show that the conditions which permit a man to do productive work may be created anywhere. At the worst, some men in the smaller universities, in the little colleges, and in whatever places may seem more unlikely, will continue to prove that creative work is free for all and is the one thing which can never be controlled by a monopoly. Wherever these men are, they prove also, directly through their pupils or indirectly through their colleagues, the vitalizing effect of research upon teaching, and so demonstrate the true bond of unity between the university and the college. No institutional conditions can wholly suppress these matters of the guild of scholars. It is, however, our main business to organize conditions which shall not tend to repress them, but which shall enable them to give their whole service to society.

In conclusion I will say that the problem of selecting from all the things which might be done the things which shall be done is the most difficult and the most imperative problem confronting the whole school system. It is not an artificial problem. The school must represent civilization. When we have detected and dismissed the fads and frills, there remains the great circle of sciences and arts which will not suffer dismissal and yet for which our long and expensive school system has not yet found enough money nor enough time. This means simply that the school has forced upon it as never before the problem of selecting its course of study.

Some of my correspondents plead for years or half years to be devoted exclusively to research. Others think that research and advanced instruction should go on simultaneously. Still others hold that the elementary student has a special claim on a little of the time of the master. Manifestly these are special cases to be treated each in its own way according to the man and the subject.

In a recent address Professor George H. Nuttall calls attention to the utter inadequateness of the provisions for research in universities or outside, in both England and America. Irrespective of the universities there should be an open career of investigation and in all the various fields of science. Such opportunities exist to a limited degree in our scientific bureaus, surveys and experiment stations, but these should be greatly multiplied, at the same time leaving them open to real talent only.

Says the London *Times:*

In one way or another every branch of research loses promising men, who either go into practical affairs with what knowledge they have or make research itself subservient to money-getting by selling crude inventions, by self-advertisement, or by cooperation with financiers. We have no hierarchy of students on a living wage basis; and as a consequence we are very short of real teachers even for practical purposes. For the real teacher must be an advanced student, not a mere parrot reciting other men's work.

Another correspondent believes in the exclusion of hack work, summer schools and other matters of minor importance which tend to lower the intellectual tone of the university professor. He says:

In cases where a chair is endowed for the expressed object of research, I would go so far as to say that the professor should not only not be required to lecture, but should not even be allowed to lecture, except, if he desires, he might give a course of not more than a dozen lectures confined strictly to an exposition of the subject on which he is engaged in investigating. Such chairs are very few in number, but still there are some. My reason for prohibiting lecturing in such cases is that there is always a temptation in universities for a professor to create a following by appealing to an audience, and the tend-

ency is to lecture more and more, with a loss of time and energy which should be spent on research itself.

Where it is not specified that the professorship is for research, my answer would be that the amount of relief from instruction ought to depend largely upon the qualifications of the professor himself. Some professors who are good lecturers and teachers and valuable as such are not by nature qualified to be investigators, except in a very limited sense. I see no reason why such persons should be relieved from doing what they can do well, on the chance that if relieved from lecturing they might do original work. At the present day there is connected with investigation an idea of superiority over the mere exposition of a subject, and most professors desire to be regarded as investigators. If, however, experience makes it probable that a professor is a good teacher but a poor investigator, I see no reason why he should be relieved of lecturing.

There remains another and a large class of professors, some of whom are good lecturers and teachers, and some of whom are not, but who have a capacity for good, original work, if allowed time for it. It is to this class of students that your question, as I understand it, especially applies. In this case it seems to me that the nature of the subject in which the professor is an expert should be considered. In the more special and technical subjects, those in which the largest additions to the stock of the world's knowledge is to be expected, but where that knowledge, when obtained, is such that it can be absorbed by a comparatively few advanced students, my opinion is that the professor should be allowed at least half of his time—or, better still, more than half of his time—for his own special work, and have the amount of his lecturing and teaching correspondingly reduced.

Other subjects, as, for instance, certain branches of political economy and history, and possibly branches of chemistry, physics and biology, are of such a nature that it may be expected that the results will be of immediate value to a considerable number of students, who, furthermore, should be encouraged to become themselves investigators. In this case it is desirable that the professors should not be so pressed by the work of instructing and lecturing that they have not sufficient time and strength left for individual work in investigation. During the college term, it seems to me that such persons should be allowed at least one third of their time for their own original work, and, what is important, *all* their college vacations.

This last point seems to me to be important, especially in subjects like biology. The tendency is to increase the number of courses in what are called 'summer schools,' as they attract students who increase the total enrollment of a college. I object strongly to having those whose whole time during the college year has been spent in lecturing and in original work, called upon to take classes in a summer school. By all professors who amount to anything the three months of summer vacation are not spent in idleness, but used for original investigation or preparation for the lectures of the year to come.

A correspondent makes the useful suggestion of occasional research professorships to be held for one year. In such appointments, work well under way should have precedence over work contemplated or merely begun. He says:

It seems to me, also, that our great universities would find it a wise policy to have each a small number of highly paid research professorships, which might perhaps not be each for any specific subject, but be assigned from time to time to members of the faculty, somewhat as fellowships are now assigned to superior students. It would add greatly to the attractiveness of university life if professors could feel that there was a chance of having their salaries kept up while for a year or two they were left entirely to devote themselves to investigation.

From others whose views in the main coincide with those of this paper I may quote a few well-put paragraphs.

A correspondent says:

I believe that the professor is, or ought to be, primarily a teacher, and that his first duty is toward his pupils. But I think that mere instruction-giving is the lesser part of his calling. It is teaching by example that best takes root, and it is the leadership into fields of new truth, of the few who have the zeal to enter, that brings the largest and most permanent returns both to the professor and to his institution. The university has a right to expect of the professor that he will give the impress of his personality to both the administration and the teaching of his department. But it has no moral right to demand that he spend all his time and energy in departmental drudgery. To what extent he should be relieved of this in order that he may engage in research will depend on many things—among

others the man, the state of his department, and the stage of his researches, an important work that is nearing completion being more worthy of concessions than one just beginning.

The making of conditions for research is but a just acknowledgment of the debt the universities owe the world of knowledge, and is the first step towards its repayment.

Another says:

Assuming the command of adequate resources, it seems to me that the extent to which professors engaged in research should be relieved from instruction is essentially an individual question, the answer to which is dependent on the relative values of the professor's work in research and in instruction. If the research is of exceptional value, the instruction should be limited to that which relates to the field of research or is tributary to it. Thus much is usually helpful to the research. If on the other hand the instructional work has markedly the higher order of merit, the research work may well be limited to that which is helpful and tributary to the instruction, as a certain amount is assumed always to be. The intermediate cases may well be subjects of special adjustment on lines intermediate between these two, precedence being given to research when it is really productive.

Another says:

Men differ in regard to the relation between research and instruction. The true investigator is born, not made, and will work whether he must teach or not, but the quality and quantity of his work will be directly proportional to the time at his disposal. On the other hand, the investigator who is the product of educational methods is likely to accomplish less as the time at his disposal increases.

The character of the work differs in different cases. Some lines of work require longer absences or longer uninterrupted periods than others.

A man who has demonstrated his ability for research should be able to command a larger proportion of his time for this purpose as he approaches mental maturity.

A distinction should be made between elementary and advanced instruction. Class work with advanced students along lines in which the instructor is personally interested as an investigator is often a great aid to research because it permits contact with other minds, discussion, and the statement in words of thoughts. The mental stimulus involved in this relation between instructor and student is often of great value.

On the other hand, the routine of general or elementary courses, largely attended, where the element of personal contact is mostly absent, often interferes seriously with research.

As the investigator develops he should be more and more free from the routine work connected with instruction.

To sum up: The point of greatest importance is that the investigator should have extended periods of time free from other duties. These should be regarded not as vacation, but as a part of his work. Certain hours in the day or certain days in the week do not meet the needs of the investigator.

Another says:

My experience has convinced me that under the system commonly followed in our universities either the students suffer for lack of attention or research is neglected; and the more eminent the teacher the more surely is this the case. For as a teacher's reputation grows, so does the number of his students increase; and the eminent investigator is forced to either lock himself into his study and neglect his students or devote his days to instruction and restrict his researches to nights, Sundays and vacations, when mind and body are worn out. In no field is it more true than in this that a man can not serve two masters.

I believe that what may be termed the intensive system gives promise of affording relief to what is obviously a very undesirable situation. If the teacher will devote all of his energies for one half of the year to imparting instruction and directing the researches of his advanced students, the students will probably gain more, in most cases, than they do under the present system. And the conscientious teacher will be able to devote the other half year to research without being constantly oppressed with the feeling that he is neglecting students who have sacrificed much in order to gain the opportunity to study with him.

Under the intensive system it would doubtless require a somewhat larger corps of teachers to care for the students than under the present system, where nominally every teacher is available for instruction all of the time. But a professor working under the intensive system would do very much more than half the amount of instruction that he does under the present system; hence the necessary increase in teachers would be less than might appear at first sight.

A correspondent says:

I hold that it is the duty of the university to advance knowledge as well as to supply instruction. So far as possible professors should be permitted to do the work for which they are most competent. If a man is able to advance knowledge to an important extent—there are in fact not many such men—it seems to me that he should be required to give only so much instruction as would be fruitful for his research work. A professor can often do the most for his students by going on with his own work, thus imparting some of his spirit to them.

Another says:

I have always had definite convictions on this subject, which have come in part from personal inclination and in part from a remark you made to me during an impressionable period, in appreciation of a research man in a neighboring institution: 'He manages to use all of his time and energy for his own work.

In every institution there are men who glory in their large classes and the popularity that comes with them, and there are others who would be just as happy in their own work without any students—as long as their salary came regularly. I see nothing inherently wrong in the position of either one of the men, and see no reason why one should look on the other with disdain or the other on the one with envy.

Another says:

In my opinion professors engaged in productive research should meet with every encouragement and assistance from the university authorities. They should be amply provided with the books, the materials and the implements needed in research, and a reasonable portion of their working time should be set free for that purpose. What proportion should be thus set free may not admit of very definite statement, but it would seem that a well-endowed institution should so limit the scope of its work and the consequent amount of instruction offered that its productive scholars could apply at the least one half of their working time in advancing knowledge. It is my opinion that increase of knowledge considered by itself alone should be one of the definite aims of a university. But if this be not granted and the primary function of the university be considered the giving of instruction, it is just as essential that the professors should be investigators. Only those who are themselves engaged in research can lead students beyond the elementary phases of their subjects.

Another says:

I should say that it is at the present time much more important that the general principle of granting time for research be recognized by the universities than that any special fraction of such time be agreed upon. The complexities of the various factors entering in to the particular exigencies or particular cases would in any event make it extremely difficult to settle wisely upon such a fraction and I certainly have no fixed opinion as to the amount which ought to be thus assigned.

Where men are proved capable of profitable research and where institutions are able to make good the loss in the amount of instruction offered, I think a third of a man's time every other year could with great profit to the university be set aside for investigation. In some cases this time would be best invested if scattered over the whole year. In other cases it would be more efficiently spent if concentrated within some given period of three to six months. In certain unusual cases it is undoubtedly judicious to give a larger amount of time than this proposal provides for. Moreover, in some cases research can be carried on with entire success in connection with advanced class work, *e. g.*, certain forms of philological studies. In such instances there is obviously less propriety in setting aside special time for investigation. But as I said at the outset, these complexities are too numerous for me to attempt handling. It will be a great step forward if the principle of recognition of research as an integral part of a first-class instructor's duties can be gained.

Another says:

In general I may say that the instructor who does not investigate is exceedingly likely to get into ruts and will soon become a 'back number.' There is nothing like research to keep one posted on the work done by others. It is a constant incentive to reading. It keeps one posted not only in his special field, but from the interrelationship of problems, it gives him constantly an outlook over what is occurring in other lines.

To what extent the instructor should be relieved from instruction is another matter. If he be entirely relieved, the students of the institution receive practically no benefit from his researches, while he loses all influence over the student. In most cases to allow a professor to devote himself

entirely to research would be a violation of trust funds supporting his chair.

Certainly, in my opinion, every person connected with an educational institution should give some instruction, and I think it would be well if the heads of departments should have some hand in the teaching of at least one elementary class. It would tend to keep at least one foot on the earth.

A correspondent says:

There are many problems of research which require a great deal of time-consuming work in the preparation of material for the study. I believe they ought to have help in the nature of assistants to do a great deal of this kind of work in preparing the material for study and investigation. A professor of horticulture or agriculture is not required to plow his ground, cultivate and harvest his crops. He is given help to do this. He plans the research, oversees perhaps the preparation of the ground and the cultivation and the harvesting, but makes his study from the results of this manual labor which has been done by others. I believe similar help should be given to professors engaged in research in some of the lines of biological work.

Another says:

Regarding the relation of research to instruction, I feel very strongly that no instructor of upper classmen in a university should teach a subject if he has not come to know the values of its elements through testing some of them under new conditions. Even if the instructor be considered apart from his chosen field, simply as an instrument for the stimulation of the thinking power, he is not in a position to teach his subject unless he has some acquaintance with creative work. If I am correct in this view, it would be true that professors engaged in research have also a very important work to perform in instruction.

Another says:

I believe that at least half the time of every professor should be definitely set aside for research, provided said professor has shown the ability and energy to devote this time for such purpose. The enhanced reputation which professors engaged in research enjoy with their students, and the more comprehensive and critical value which it gives to their lectures and other forms of instruction, will more than compensate their institutions for the time set aside for this purpose. It is not men of routine, but men of original ideas, who are the most stimulating to students, and originality can only be generated and kept alive by research. Proof of this is found in the fact that the most inspiring teachers of all time have been investigators. Investigation can not be carried on with the brain fatigued by excessive teaching and excessive hours of administration. In many cases I believe the number of lectures and recitation hours could be substantially reduced with advantage both to the professors and to the students in institutions where owing to limited means a large corps can not be employed.

Another says:

An ideal research position, to my mind, would be one in which there was some teaching, but never enough to endanger the *continuity* of research.

Another says:

I should be very sorry to see our universities making any formal arrangements with their officers looking toward supporting them in research. In my judgment that would divert the universities from their own proper work and would give us a low grade of research. Hitherto research work has been the expression of the spontaneous interest and energy of the searcher, and I look with suspicion on any intrusion of the spirit of working for pay into this field. Yet I can see that in individual instances, where it is known that a man is engaged in an important research, it would be wise to relieve him of some portion of his other daily work. But I should hope such indulgence would never go to the point of making research the subject of contract.

Another says:

The scholarly men make the best teachers. I am not at all sure that the practise of teaching benefits the man of research. This would seem to be the case with the direction of the research of capable graduate students—but elementary teaching may be not only irrelevant to the scholarly interest, but distracting and fatiguing to the point of the exhaustion of energy and the atrophy of interest. I do feel, however, that the man of research is the safest person to whom to intrust the college student. Such a teacher is sure to win and to merit respect, for he measures himself by standards that are objective and intelligible to all.

The teacher who is not a scholar may be a winning and beneficent personality, but he is more likely to be a self-constituted oracle whose

dilettanteism is quite patent to the average undergraduate.

It seems to me clear that no educational system can afford to be dependent upon the chances of genius and temperament, even where these do slightly favor the unscholarly man. But as a matter of fact the chances seem to favor the scholar.

The great academic personalities seem, to my recollection, to have been men who enjoyed the dignity and the straightforwardness of scholars.

I believe therefore, that it is to the advantage of the university to have the same men discover and teach the truth. Professors should not be relieved of instruction, if this is to result in the specialization of the teaching function and the research function.

Furthermore, I do not see any possibility of fairly discriminating between individuals in this respect. The one or the other class (and under present conditions it is bound to be the teaching class, because of the recognition the scholar receives from outside) will be a degraded class, and this I should imagine to be fruitful of discord and jealousy.

I can not see that a moderate amount of instruction can interfere with a man's scholarship, and it is likely to afford him the sort of social service that he needs for his manhood.

I should suppose, then, that it would be wisest to make the required amount of instruction uniform and fix it at a moderate number of hours—say ten per week.

Still another says:

In many cases the complaints of professors that they have not sufficient time for research work, because of the undue amount of instructional work required of them, are not well founded, but are rather due to an inherent incapacity upon the part of the men to do effective research work, which they attribute to the large amount of teaching which they have to accomplish rather than to a natural dislike of hard work.

Another says:

Roughly stated, it is the function of a university to discover and disseminate truth, to train scholars, and to develop character. The relative stress laid upon these competing ends must vary with the conditions surrounding the institution, and in a specific case must be affected by the characteristics of the teacher, of his subject, and of his students, and also by the public opinion in the constituency of the institution and in its faculty and trustees. That public opinion seems to me to be adjusted into rough conformity with what average amount of instruction should be expected from the average teacher, and I should be disposed to regard this as the best basis available, to be deviated from in individual cases as circumstances might indicate.

In my own case, for example, I doubt that it would be wise for Cornell University to leave me more free from duties of instruction, with the deliberate purpose of letting me give more time to research. Such relief would make me less effective, I am convinced, as a teacher, and could be justified only if it was felt that my efficiency in research was greater than my efficiency as a teacher, or else that the need for research in my special field was greater. In some lines of work I believe it might be wise for the institution to provide a small group of junior appointees who might give all their time to research, and to allow ready transfer from the class of junior appointees whose main work was teaching to the class whose sole work was research, and the other way.

Another says:

I am strongly of the opinion that a university which is aiming at the highest ideals of university work should, when it finds men of real and proved capacity for original research of a high order, relieve them as far as possible of educational and administrative drudgery, though there can be no doubt that our universities probably could not afford to do this in the case of a very large number of their professors, nor perhaps would this be desirable. In point of fact, however, men of the type I have in mind are not numerous in any university. I believe that the activity of such men in a university brings in a very rich return through the atmosphere and example which it creates, and it seems to me that the best service of such men to their university lies in their own research work and that of the advanced students who come under their direction and influence.

I believe that such a man, for example, as Balfour did far more for his university in this way than through his lectures and other routine work, but I also think that to remove such men wholly from contact with the students would be a mistake from every point of view. My feeling is that such men should be relieved as far as possible from the drudgery of class work, elementary laboratory instruction, and above all, from administrative detail, for which they are very often unfitted by taste and temperament. I do not have in mind so much the time that is given to

these things, as the diversion of attention in directions wholly foreign to that in which their original work lies, and the destruction of that unconscious cerebration which is one of the most important factors in working out scientific results.

At the same time I fully recognize that a university is also a body of students that must be systematically taught, and I do not think that the work of the effective teacher should be considered as in any way inferior to that of the investigator, nor should professors whose first instinct is that of the teacher, be led to feel that their advancement depends on the accomplishment of original work.

You doubtless know better than I that investigation that is done under pressure of this kind is oftentimes a rather poor pretense. The tendency seems to me to be to differentiate these two types of university professors, and it is probably on the whole a good division of labor.

One thing seems to me quite certain, and that is that our universities will not attain their real aim until they are prepared to give full opportunities for research to men of the first type I have indicated. These are the men who form the real nucleus of the university, and their presence and labors seem to me of more importance from the point of view of real university work than all the rest of our educational machinery put together.

President Woodward, of the Carnegie Institution, says:

The way I put it to myself is this: Can we expect a college professor to do as good work of research for our institution as we might expect from him if he were taken over to the institution and had no work but that of research? Much experience convinces me that work of instruction is very valuable to a man who is pursuing investigation. On the other hand, I find that most men who are pursuing at once work of instruction and investigation in the colleges are giving only the smaller fraction of their time to investigation. Their first duty is toward the institutions with which they are connected, and any man who is efficient as an investigator is also likely to be efficient as an administrator and as a worker on the numerous committees essential to educational institutions. My personal experience and observation would seem to show that here again the work of investigation is commonly given second place.

On one point there is little or no room for doubt, namely, that the work of investigation done by professors and instructors in our American universities has only lately come to be justly appreciated, especially by trustees and regents.

From the point of view of an educational institution, there is likewise another point quite clear to me, namely, that no man can be an instructor of the highest grade without he is also simultaneously at work in some sort of research connected with his work of instruction.

Here I must close my quotations, resisting all temptation to continue. For in fifty other letters I find important considerations pithily stated. But as these all agree more or less distinctly with my own thesis, I must suppress them for the present on the principle adopted some ten centuries ago in burning the library at Alexandria.

SCIENTIFIC BOOKS.

The Dynamics of Living Matter. By JACQUES LOEB. (Columbia University Biological Series, VIII.) New York, The Columbia University Press. 1906. The Macmillan Company, agents.

This interesting book owes its origin to a series of eight lectures delivered by the author at Columbia University in the spring of 1902. The aim of the lectures was to give a presentation of the author's researches on the dynamics of living matter and the views to which they led him. In the present book, however, Loeb gives quite a complete survey of the modern problems of experimental biology, records a great many interesting facts and laws which were recently discovered in this field and discusses them from a broad point of view. The book still retains the division into lectures which are here extended to twelve.

The following quotations from the introductory remarks (lecture I.) inform us of the philosophical attitude of the author towards biological problems. "In these lectures," he says, "we shall consider living organisms as chemical machines, consisting essentially of colloidal material, which possess the peculiarities of automatically developing, preserving, and reproducing themselves." He