# SCIENCE

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## *THE UNIVERSITIES AND INVESTIGATION*[1]

As a representative of the university and as one but recently come to live among you, it is perhaps fitting that I should use the opportunity which President Hall has so kindly given me to discuss certain phases of university work in which many of my own chief interests lie, but which are not often brought before the attention of our public. I refer to the relations of the universities of the country to original investigation, and particularly to scientific investigation, since it is with a part of this—and necessarily in these days of specialization a small part—that I am personally concerned. Many of us in America have lived through a period in which the purposes and scope of the universities were at first not very clearly conceived; but as time has passed the situation has changed, and on the whole an agreement now prevails, which is likely to be permanent, regarding certain features of university policy which once were subjects of dispute. One of these is that investigation is an essential part of the work of every university. We now recognize that the universities have a double function to perform: one, that of disseminating liberal and scientific knowledge; the other, that of adding to it. There is nothing new in the idea that the chief concern of universities is liberal knowledge; *i. e.*, knowledge of a kind not directed primarily toward special or utilitarian or personal ends, but scientific or humane knowledge, relating especially to those matters which have a broad human significance and general applica-

[1] Founder's Day Address at Clark University.

bility. But in America it is only within the past twenty-five or thirty years that the universities have generally come to recognize it as their function to extend, as well as to maintain and transmit, such knowledge in all departments of learning. In a sense this is the more fundamental task of the two, since the attainment of scientific knowledge must precede its use in instruction or practical application; and it is perhaps the chief distinction of Clark University that it was one of the first to recognize and act on this principle. The day devoted to the memory of its founder seems thus an especially appropriate time for such a discussion.

Now investigation, in the scholarly or scientific sphere, means something more than the mere attempt to find something new. It means primarily all activity directed simply and solely toward the advancement of liberal knowledge—knowledge, that is, not of special or local or purely practical matters, but knowledge in its broader, more theoretical or purely humane aspects,—those which are concerned not so much with meeting the immediate occasion as with furnishing a generally valid basis of principles and methods that can be applied at will to all of the affairs of life. Breadth of application should be the main characteristic of this type of knowledge; it should meet not only the purposes of practical life, but also those of science and art, besides serving for the realization of the higher ideals of culture and conduct. The investigator knows that we can not assume all desirable knowledge of this kind to be already in existence and to be had for the asking; what we already possess has been gained chiefly by the prolonged and devoted efforts of previous investigators, working sometimes alone, sometimes in conjunction with others, and usually in universities or other institutions of learning; and we have to see to it that the task is carried on. That the task itself is a worthy one admits of no dispute; incalculable good has come to humanity through its means, and no doubt will continue to come if our efforts do not relax.

Why do so many seek knowledge without being seriously concerned about its application? This question is often asked, and its answer has puzzled many sincere persons. In various fields of science and culture we find men who seek knowledge with no other aim than to possess it. Is this aim worthy? Many, especially in these times, express doubts. Some even denounce such search as selfish. One hears such expressions as the selfishness of cultured persons. Yet those who do possess knowledge —worth calling by the name—are rarely troubled by such doubts. When Solomon rated wisdom as better than rubies, he no doubt expected that philosophers in general would agree with him, but not all other persons. Is it that a certain native endowment of intellect or temperament is required to take satisfaction in knowledge as knowledge, just as others delight in art as art? This is true in a measure, certainly; and the tendency has to be recognized and I believe encouraged. It is doubtful if an investigator or scholar in any field can be truly effective without this disinterested curiosity or simple desire to know; so that we must regard love of knowledge, even if it does not eventuate in action of any kind, as in itself desirable. Perhaps it is as well for it not to exist alone, but that is another question. There are, however, other and profounder—I might say biological—justifications for this tendency. Knowledge, in the biological interpretation, is the chief means of adjustment to the conditions of life. This is clear enough in practical life; if we *understand* a situation—have it clearly and accurately conceived in advance —we are better able to deal with it. The

same is true of even abstract or remote knowledge of the purely scholarly kind; it is *potential* means of adjustment; the cultured man knows how to adapt himself to most circumstances better than the uncultured man. Not only mankind, but all living organisms—both animals and plants—are so organized that their well-being depends on accurate adjustment to the conditions under which they live. The give and take of material and energy must balance; the term "adaptation" means simply the sum-total of the conditions that secure this balance. Now, for us men, the chief means of such adjustment is knowledge. Theoretical or abstract knowledge, the kind that investigators in pure science strive for, is merely that which is the most universally valid and applicable; it is therefore at bottom the most practical; so that if the chief aim of scientific investigation is the attainment of such knowledge, and even if the wish to attain it is often purely instinctive and unreasoned—as in fact it is in many of the best investigators—we can understand from the biological point of view why this should be so. Thus there is the best of sanctions for the knowledge-seeking tendency. Breadth of knowledge represents a surplus or reserve of potential activity,—whether it is actually called upon for use or not; and as such it is the most valuable possession that we can have, for it is the means by which purposes of any kind are rendered capable of realization.

Now let me define a little more fully what scientific men mean by investigation. Under this term come all efforts directed toward the one aim—the ascertainment of the clear, impersonal and objective truth concerning the matter in hand. Mankind has found no method that leads so certainly to the attainment of this end as the method of dispassionate, systematic and critical inquiry, using all available means impartially and thoroughly, and verifying all results once they are attained. In this sense scientific investigation is in no way different in its method from investigation in other fields, such as history, language or philosophy, or from the means which a good military commander or man of affairs adopts in familiarizing himself with a situation before he acts. In every case the aim is to ascertain impartially the actuality of the case, that which is *so*, quite independently of what our wishes or fears or other prepossessions may be. The means which we adopt may vary in different fields of investigation according to the nature of the matter under investigation; but the attitude of the true investigator is the same everywhere—an attitude of candid, critical, persistent and, above all, disinterested inquiry. It is important to realize the necessity for these qualities in the investigator, if true results are to be attained. Without them the purpose of investigation can not be realized; progress is slow, and results do not bear examination. Let me quote Faraday's conception of the natural philosopher—by which he means the investigator in natural science: "The philosopher," says Faraday, "should be a man willing to listen to every suggestion, but determined to judge for himself. He should not be biased by appearances; have no favorite hypotheses; be of no school and in doctrine have no master. He should not be a respecter of persons, but of things. If to these qualities be added industry, he may indeed hope to walk within the veil of the temple of nature." Here we have a statement, clear, simple and devoid of literary artifice, by one of the most fruitful scientific investigators of all times; and when we wonder at what has been accomplished by the science which has developed from beginnings largely made by him, we should remember that it is only by such men, working in such a spirit, that

the more fundamental truths can be brought to light. When, therefore, we say that we wish to encourage investigation, we really mean that we wish to encourage those who have the right spirit of investigation. Progress is due mainly to such men; and it is important in the interests of this progress that the universities, which devote so large a part of their resources to the work of investigation, should clearly recognize that the personal factor is still—as it was in Faraday's day—the all-essential. Knowledge, insight, and power of accomplishment are not in laboratories, libraries and organized institutions merely, but chiefly in those who put such means to their right uses.

It is needless, before an audience of this kind, to justify scientific investigation or to attempt to set forth something of what it has accomplished. I may, however, point out—since this has a bearing on much of what I wish to say later—one consideration which the world at large is prone to forget unless frequently reminded, namely, that it is the *fundamental* investigations which are chiefly important for science, and lay the foundations for those later applications affecting mankind generally. Thus in this sense we owe wireless telegraphy to Maxwell and Hertz rather than to Marconi, our freedom from many forms of disease to Pasteur, our mastery of the air to Langley and the others who studied the lifting power of moving planes; and many other similar examples could be given. In general we may say that if an adequate body of theoretical knowledge has once been gained, it is a relatively easy matter to make the desired practical applications. It is when there is no guiding theory and we have to work empirically that problems are difficult or impossible of solution. But if we know beforehand of any task that nothing but hard work and persistence is necessary for its accomplishment, we may say that there is no serious difficulty, for these qualities can be commanded at will in any civilized society. When, however, we lack the necessary knowledge of fundamentals, little or nothing can be done. I may here furnish an illustration from biological science. Until the relation of microorganisms to disease was discovered by Pasteur, physicians were almost helpless in many departments of medicine; but once this relation was established, means for indefinite advance were at once furnished; then, to use Ehrlich's phrase, "diligent empiricism" was all that was needed to master many problems of pathology; and, these once mastered, effective methods of diagnosis and treatment were forthcoming sooner or later. The relation of Faraday to electrical science is similar; and in the same sense engineering, scientific agriculture and mining, many valuable manufacturing industries, in short, all that is most characteristic in the material foundation of our civilization, could never have come into existence without the previous development of the pure sciences of physics, geology, chemistry and mathematics. Other and less tangible results are of equal importance, but it would lead too far to speak of these. I wish simply to make it clear that the fundamental knowledge must first be gained; and it is the task of the investigator to supply this knowledge. This he can do only by prolonged study, observation and experiment, directed toward the simple purpose of obtaining as full and clear insight as possible. In the pursuit of this aim problems inevitably arise that are both difficult and remote from popular interests; yet such problems must be solved, and it is largely for the purpose of providing opportunity and facilities for their solution that universities exist. This is why the greater part of research in pure science is necessarily conducted in the uni-

versities. On the other hand, experience has shown that those parts of scientific work which relate directly to useful applications can be carried on successfully under the pressure of general public demand; the material rewards of successful invention are a sufficient incentive to inventors. This, however, has never been true of investigation in fundamental fields of pure science, and it is difficult to see how it ever can be true. Such work itself is its own chief reward. Isolated men of genius may make great discoveries, as Boyle, Cavendish and Darwin have done in England; but in such cases fortunate circumstances and leisure are essential, and the number of such men is very small. For most investigators the opportunity of engaging in purely scientific or scholarly investigations is to be found only in the universities. The relation of universities to fundamental scientific progress is thus a peculiarly intimate one.

Advance in knowledge, as distinguished from the maintenance and application of existing knowledge, thus depends ultimately on the work of the investigator, and chiefly on the investigator in the university. If he is to accomplish his function he must direct his efforts to the practicable, under conditions that are favorable to his work—or at least not too unfavorable, for good will and talent can accomplish much in spite of adverse conditions. First, what is practicable? In his "Advancement of Learning" Bacon, the first advocate of systematic investigation, says:

> I take it those things are to be held possible which may be done by some person though not by every one, and which may be done by many, but not by any one, and which may be done in a succession of ages though not within the hourglass of one man's life; and which may be done by public designation though not by private endeavor.[2]

[2] I wish to express my indebtedness for this quotation to Dr. Mall's interesting article in the *Journal of the American Medical Association*, 1913, Vol. 60, p. 1599.

Bacon thus recognizes that many projects call for collective and coordinated endeavor, while others require individuals gifted with the necessary talents or opportunity. Collective action and individual action both play a part, and this is as true of the advance of science as of any other form of enterprise. Now it is a characteristic of our time and country that more stress seems to be laid on the importance of collective action or cooperation in scientific research, than on the importance of giving scope to the single investigator of original scientific genius. Whether this tendency is right or wrong I need not discuss just now. It is clear that cooperative research is essential for the solution of many scientific problems, especially those requiring the accumulation and coordination of large masses of data. Much of the work in statistics, heredity, astronomy, geology, sociology, and other sciences is of this nature; here are illustrated Bacon's classes of work "which may be done by many, but not by any one, or which may be done by public designation but not by private endeavor"; one has only to think of what is done by geological surveys, statistical associations, or scientific societies. Work which can not be done "within the hourglass of one man's life" may be well within the scope of an association; thus we have investigations relating to natural events which recur infrequently, like earthquakes or sunspot periods, or to processes which take place very slowly, like evolutionary changes in organisms, star movements, or other cosmic changes. Only the coordinated work of generations can throw light on such matters. Cooperative research thus plays an important part in the science of to-day, and there is a strong tendency on the part of many scientific men to insist on its all-sufficiency, and to regard the work of isolated or independent investigators as of minor consequence.

Bacon, however, mentions first of all the class of achievements that are possible to some one person, though not to every one. That in certain spheres of activity one person may be indefinitely superior to any other or even to any combination of others was familiar enough to Bacon, and social conditions were not then such as to obscure this truth or throw doubt upon it. Being a man of genius himself and an advocate of progress, he could not underrate the part which personal originality and power of invention play in progress; he knew that such qualities are of individual and not of social origin, although they naturally flourish best in a favorable social environment. It is perhaps time to protest against the tendency to undervalue detached investigators, which insists that every one shall work chiefly in cooperation with a group and for a collective aim. This tendency is undoubtedly strong at present, especially in America, because here the democratic spirit is more dominant than anywhere else and is subject to fewer corrective influences; and the resulting bias toward collectivism tends to lower the estimate placed on purely personal or individual qualities. Now reliance on "team-play" is well enough in its place; it plays an indispensable part in many undertakings. But such a spirit cannot be depended on to promote scientific progress by itself; in this sphere it is at best rather an accessory. The truth is that so far from progress depending on collective effort, the whole history of science shows that the guiding and fruitful ideas, those which form the seeds of later developments, nearly always originate in the minds of a few scattered thinkers or investigators, often working in isolation. Is there any reason to believe that this will not continue to be the case? Yet high scientific authority seems at times to encourage that belief. President Woodward, of the Carnegie Institution, in a recent address[3] warns his hearers against entertaining what he calls the subtle error that

> the more remarkable results of research are produced not by the better balanced minds, but by aberrant types of mind popularly designated by that word of ghostly if not ghastly implications, namely, genius.

Again he says:

> The more striking results of research, quite commonly in the past attributed to wizards and genii, and still so attributed by a majority perhaps of contemporary writers for the popular press, are now understood by the thoughtful to be the products rather of industry, sanity and prolonged labor than of any superhuman faculties.

Others extol cooperative research as the highest type of scientific work. But surely what is understood by scientific genius is not a wizard-like faculty of arriving at immediate and astonishing results, but rather that power of clear, imaginative and valid insight into phenomena which is the product of high native endowment combined with industry, sanity and prolonged labor. The peculiarities of pseudo-genius—which no doubt has besieged the Carnegie Institution for support from the beginning—should not be allowed to cast discredit on true genius, a totally different thing. When we understand clearly what scientific genius really is, we must recognize that it is no less indispensable to the production of the highest scientific work than is poetical genius to the production of the highest poetry. Every-day experience proves that industry, sanity and prolonged labor are not sufficient for the best work in any domain. It would be fortunate for humanity if it were so; for these qualities are not rare, and are in a measure attainable by all normal persons. Genius is not these—although when these are added genius may become more effective. Unfortunately—or perhaps fortunately—it evades rules; but it seems to

[3] SCIENCE, 1914, N. S., Vol. 40, p. 217.

include a strong instinctive element which appropriates or rejects the material which is presented to it—either by its own vivid imagination or by outside experience—according to the availability for the purposes that interest the genius. And this interest is likely to be absorbing to an extreme degree, and hence to arouse all the energies much more effectually than is usually possible to normal persons. But it is not necessary here to prejudge questions which are still a puzzle to psychologists. I wish merely to emphasize that whatever a final analysis may eventually show genius to be, there is no doubt of its existence, that it is rare, and that the chief achievements of mankind in science, as in art and literature, are due in the main to its activity. Only by recognizing these facts shall we be able to take properly into account all of the factors which contribute to scientific progress, and make due provision for all. If Darwin had been without means, there is no doubt that the most effectual way of promoting evolutionary science in his day would have been to provide him with an adequate personal endowment, or a university chair giving complete freedom for research. I emphasize this in order to bring to your attention the all-importance of the individual or personal factor in the work of scientific investigation. This consideration is a wholesome one for moderns to bear in mind; for the trust in cooperative methods, "team-play," and collective enterprise is so general, and has assumed such a dogmatic character, that it tends to deprive many persons—especially those whose talents are of a subtle rather than a robust order—of belief in their unaided personal powers, and hence to weaken their sense of personal responsibility. One result of this often is that they lose the normal and healthy compunction against laying up their talents in napkins.

Let us now return to our original subject. One of our aims in the universities is to further investigation. How are we to do this most effectually? The answer, in form at least, seems simple. First we must provide facilities, and second, we must have the right men. The first requirement is relatively easy; it is a question of material resources; the second is more difficult, as well as more important, for if it is impossible to make bricks without straw, it is still more certain that the best of straw will serve little for brick-making unless put into the right hands. But let us define a little more closely what we may regard as the conditions of successful research, with especial reference to the case of scientific departments in universities. In general three things are necessary; equipment, proper coordination of activities (or organization) and personnel. When these are combined in the right proportions we may hold that conditions are the most favorable; but this is not always possible, and usually some choice has to be made; which is the most important and fundamental? This question is not easy to answer; so much depends on what is under investigation; a completely and expensively equipped laboratory can undertake researches which are beyond the reach of one of more modest resources; and yet the difference in the importance of the results gained by the two may not be commensurate. Here we see the significance of the personal factor. Darwin will make important discoveries in his kitchen or back yard, while a costly laboratory, although making a great show of activity, may be comparatively fruitless in important results. This fact, however, does not make it any the less desirable that the apparatus for research should be at hand; but it indicates that if results are to come, such means should be used properly, and this can be done only by the right men. Appeals for

equipment have on the whole been well met in this country; and our relative lack of scientific productivity has little if any relation to lack of equipment. Nor is it for lack of numbers and organization that the universities fall short in scientific productivity. Everything that organization and system can do is done in our larger universities. Officers from the president down are numerous and minutely graded, hierarchy within hierarchy; there are departments and subdepartments; every subject is represented by one or more specialists; the courses given in a large department are numerous and detailed and cover all phases of the subject. The work of students is carefully supervised; so many credits go to the making of a master's, so many to a doctor's degree. No one is idle for a minute. The mere mechanism requires exacting care; the head of a department must often be primarily an executive; much of the time is given to duties of management; the telephone, the typewriter and the card-index are as much a part of his equipment as of the business magnate's. It would seem as if all of this machinery ought to be effective. Yet misgivings force their way in. There is reason to think that this faith in the efficacy of organization in university work is not derived from experience, but rather from a preconceived belief that methods which are so effective in practical life ought to be equally so in the intellectual life. But is this really so? Many of us have grave doubts. In our own private studies devotion to card-catalogues and notebooks can go too far, as many a man has found from bitter and paralyzing experience. Is it really true that the letter killeth, but the spirit giveth life? There must be conditions more important than equipment and organization—conditions which are somehow lacking. What are they and how can they be furnished?

It is for the universities to make the right answer to this question, and also to rectify the conditions. The majority of productive scholars and investigators are connected with universities. If the scientific productivity of the nation is less than it ought to be, as we see when we compare ourselves with Germany, France or England, we can only ascribe the deficiency to the presence of unsatisfactory conditions in the universities. What are these? and how are they to be removed?

Such a question carries very far and admits of no off-hand answer. The universities represent the intellectual tendencies of the country. They are, or ought to be, one of the chief sources of what is highest in its civilization. Why do fundamentally important contributions to science or scholarship come so infrequently? and is there any way of making them come more frequently? What man has done man can do: there must be some restricting and removable conditions which either prevent original investigators from doing their full quota of good work, or it may be prevent the creative type of scholar from finding his way into the universities in the numbers that we have a right to expect. What the chief of these conditions are, and how all those interested in the welfare of our institutions of learning can aid in their removal and replacement by better, is what I shall now try briefly to indicate. I ought perhaps to say that I offer my suggestions in a far from dogmatic spirit, being aware that the problem is highly complex, and that no one man can be fully familiar with all of its aspects.

When we look at our universities we are impressed with certain obvious peculiarities —their size, their wealth, the variety and complexity of their activities and of their organization. We may agree that size and wealth with the resources that they bring

are all very well—in themselves desirable—but complexity of organization, and the practises and tendencies that go with it? are these conducive to the intellectual life? This, in my opinion, is the critical question. So far from our taking this for granted, there is good reason to believe that beyond a certain limit dependence on system and organization in institutions of learning is directly injurious to good work, and this for the simple reason that it makes for the stereotyping of activities, and hence interferes with freedom and its expression, which is originality. Such restriction in fact is the general purpose of organization; it aims at diminishing variation from an accepted norm. Now the more stereotyped certain things are the better; thus a railway service or a department store can not be too regular and dependable; but if our aim is not simply to repeat things already done, but to discover new truth, the conditions that surround us, as well as our own temper of mind, should so far as possible encourage independent activity, and not simply that carried out in accordance with a program. In brief, purely routine activities should be subordinated in an institution of higher learning; all needless machinery should be disposed of, and the rest should be relegated to its proper place. This is a practical suggestion, and it is one of the first that I should make.

I do not, of course, wish to propose anything impracticable, and I am aware that a certain degree of established order, inseparable from organization of some kind, is necessary to stability and efficiency even in an institution devoted purely to research. But what I maintain is that the aim should be a minimum rather than a maximum of organization, and that the ideal toward which universities should work, if they regard original scholarship as something which it is their serious duty to further, is the attainment of the greatest possible freedom in the work of the individual departments and of the scholars making up those departments. A system of separate colleges, as in the English universities, or of autonomous departments, as in the German and some American universities, seems to give the best results. Such an ideal should not be left to chance, but it should be held consciously; and every one in the university should regard such freedom as the chief condition of his effective activity and should oppose vigorously every attempt to infringe upon it. Liberation must come from within rather than from without, and as the result of a more widespread insistence on the importance of personal freedom and initiative. This spirit would be incompatible with the over-developed autocracy that has aroused so much complaint. Freedom from merely petty and distracting activities would then soon come, and more men would give the best part of their attention to things that are seriously worth while.

The university should be the stronghold of individuality. Every one's serious interests should be respected and furthered so far as possible, both out of regard for personal freedom, and also because we do not know what their potential value may be. Remember that our aim as original scholars is not simply to impart what is already known and valued, but to produce something new, whose value to the world may not be in the least evident at first. But who can tell what its value may be later? Besides, it may be of value to the few if not to the many. We must recognize that the needs of men are as various as their characters and capabilities. A tolerance, open-mindedness, and detachment are thus of the essence of true academic life. An unwillingness to interfere needlessly, coupled with a determination to adhere by

high standards, may indeed be said to be the chief criterion of a high civilization.

There is reason to believe that the democratic movement of our time has in many ways been unfavorable to the development of strong individuality in the fields of science, literature and the arts. The collective spirit is now dominant, especially in America, and even in academic life many are unduly influenced by the desire of producing work which will make a direct appeal to the community at large, rather than work which is new and meritorious in itself, irrespective of whether it is popular or not. This spirit is inconsistent with disinterestedness, and hence tends to repress originality. It is hard to escape its influence; it constitutes an atmosphere—that element which is at once the most intangible and the most essential to life. We can however resist it if we only wish; and a spirit of independence or self-respect, that refuses to have its standards determined by anything short of firmly grounded personal conviction is the best safeguard. There is a sense in which too easy submission to the prejudices of a majority is like too easy submission to the dictates of a king or emperor. In either case the result is weakening to individuality, and hence to all work, like the work of scholarship, which demands independence and individuality.

We must remember that we are living in a time which tends to regard the collective welfare as the chief if not the only legitimate object of action. In one sense this is a great source of encouragement; it augurs well for the future of humanity at large; but it has its drawbacks. Little attention is paid, except by a few detached persons here and there, to the danger of having the whole national spirit dominated by the belief that nothing but work in the interest of large numbers is of any importance. Related to this is another very characteristic tendency. Where so many questions in politics and practical life are decided by counting of heads, a strong bias in favor of mere numbers is inevitable. Now there may be no disadvantage in this unless it becomes instinctive, *i. e.*, acted upon automatically and uncritically; but it is just this instinctive prejudice that prevails so strongly nowadays. All forms of activity share its influence; and it shows itself in educational institutions and universities in such phenomena as an over-insistence on the importance of large enrolments, the conferring of too numerous degrees, and a distinct and widespread tendency to leniency in the standards of quality. Public opinion in a democracy favors these manifestations, and an institution dependent on public opinion for its support can not afford to be too unsympathetic toward them. But a danger lies here, which is perhaps the more insidious since it can be recognized and guarded against by comparatively few. If we work only in the interest of and at the bid of majorities, we are in grave danger of disregarding the claims of the minorities. And this means undervaluing those types of person who are necessarily always in the minority, *i. e.*, exceptional persons of all kinds. The curious result follows that in a democracy, the political system which is theoretically the most favorable to liberty, the individual, regarded as an individual—and not as representative of a group (whose numbers may entitle it to respect)—often meets with little consideration. In other words, too much respect for collectivism tends to impair the respect which is due the individual, and personal liberty suffers. There arises a tendency to treat all persons in the mass, undiscriminatingly; and necessary distinctions fail to be made. Complaints of the low estimate which the democracies of England, France and America place on even the best and most gifted in-

dividuals have been appearing somewhat frequently of late; Faguet even says that the equalitarianism of the time leads to a distrust of all but mediocre persons in every capacity, and indeed favors a cult of incompetence; and he ascribes much of the inefficiency and shiftlessness of democracies to this tendency. This may be partly overstatement for purposes of emphasis; but it is at least clear that if the universities are to do their best work they should be consciously on their guard against such tendencies. We must remember that in a sense the statement that all men are equal is a dogma adopted primarily for political purposes; as such it embodies an important principle, and it serves to simplify the technique of representative government; but it was never meant to controvert plain facts. In any case we must avoid being influenced by it to the extent of disregarding talent and failing to do our best to single it out and develop it. Real progress can come only in this way. This policy, however, seems to be unpopular at present, and as a rule is little acted on in our universities. Thus the attempt to make a definite distinction between "honor" men and "pass" men—a distinction corresponding on the whole to that between those who seriously wish to study a subject and those who have no particular interest in it—is opposed as undemocratic. One often gains the impression that talented students do not try their best, because they have a feeling that it is not quite considerate or democratic for one man to prove himself the intellectual superior of another. Why this should be so is one of the mysteries; there is no such feeling about games like tennis. It may be that it represents a defensive reaction in the biological sense; it is said that white sparrows are badly treated by normal birds; and no doubt many persons feel safer when they identify themselves with a group than when they stand alone. The spirit of hostility to distinction is, however, peculiarly out of place in universities. It is difficult to judge our own community and our own time; we are subject to the fallacy of nearness; but there is little doubt that a general desire to regulate the activities of the individual in the supposed interest of the group is at present one of the most characteristic manifestations of the time-spirit, and that a submission to this desire by persons who think it democratic so to submit is responsible for a certain lack of distinction and originality in the intellectual activities of the day. The way in which organizations and societies flourish is a symptom of this; the remark has recently been made that whenever two or three are gathered together nowadays some one else is sure to be on his way to organize them; and this propensity encourages the individual in a kind of fatalistic belief that he can accomplish nothing working alone. Under these conditions, if he fails, he is often inclined to cast the blame on the organization to which he belongs or on the community rather than on himself.

It is essential that we should continue to regard the university as a place where individual talents of the most special kind will receive encouragement and development, as a place of preparation for leadership, and equally for the discouragement of any inclination to lean unduly on the rest of the community. The university man should be able to think for himself and by himself. No one can say what the potentiality of any one may be; if, therefore, a student is conscious that he has any special bent or enthusiasm for any subject, he should not hesitate to give his chief energies to its cultivation. It may be that he will meet with little sympathy from the outside world, or even from his intimates; but this should be no cause for discouragement. The univer-

sity exists largely to give opportunity to men of this kind. He must get over the feeling that it is necessary, or at least fitting, to apologize for the unpractical nature of his activities. The university is aware that many things can be done only by taking thought, just as others require immediate action without any particular thought. There is inevitably isolation and detachment in much of the work of universities; this is especially true of the work of investigation. Remember Wordsworth's lines on Newton's statue at Cambridge University:

> The marble index of a mind forever
> Wandering through strange fields of thought alone.

The withdrawal of such a man from the world is deliberate; only so can his purposes be achieved.

This withdrawal imprints a characteristic quality on academic life, with which it is often reproached. The very word academic is often popularly or journalistically used to signify remoteness from actuality. It might with equal justice be used as signifying *nearness* to actuality; but the fact is simply that the university recognizes as important or even pressing actualities many matters which to the world at large are virtually non-existent. The apparent ineffectuality of much academic work is a serious grievance to many people; and certain movements directed toward the radical modification of time-honored academic usages and privileges have arisen as the expression of this feeling; some persons, no doubt conscientious, have favored a system of supervision and time-keeping, with the object—laudable, no doubt, if only it were practicable—of making sure that the holders of university chairs do not waste their time. But it is just here that the uninitiated judgment is likely to lose its bearings; and we may well continue to repeat with the Sybil: "Procul este, profani!" Who is to be the judge in these matters? Who will guard the guardians? What constitutes effectuality in the intellectual sphere? We must refuse to be misguided by false criteria in these matters. What is most effectual in the activities of the scholar can not always be discerned even by his immediate associates. Nothing but the perfect witness of all-judging Jove would suffice for this. The true criteria are not evident to those ignorant of his work; and in forming an estimate of its value, confidence and respect for individuality have to be combined with the judgment passed by his peers in the learned world. If for lack of sympathy or special knowledge we fail to see the value of certain fields of scholarly work, there is nothing for it but to accept the assurances of those who know. Their judgment is likely to be critical enough, and not to err on the side of leniency. All plans of imposing upon the scholar rigid requirements from without—apart from the necessary responsibilities of teaching and contributing to his subject—are impracticable. I have mentioned certain recent attempts directed toward a closer external oversight of academic work; the authors of these attempts have urged that it would be well, in the interests of "efficiency," to estimate more closely the time which the occupants of university chairs devote daily to research, to teaching and to other activities. This is officialism run mad, you may say; but there the fact stands. Some one, well known as a defender of academic freedom, has remarked that the only really effective scientific mind works twenty-four hours a day. In saying this he may have had in mind Landor's passage:

> The capacious mind neither rises nor sinks, neither labors nor rests, in vain; even in those intervals when it loses the consciousness of its powers it acquires or recovers strength, as the body does by sleep.

If this is true, it is clear that all such attempts to enforce scientific productivity—usually under the delusion that it represents measurable and controllable "output" like the products of a factory—are futile, and overlook the essential requirements of all original work, which are simply opportunity, freedom from needless distraction, and the necessary leisure.

Regarding this last requirement a word or two is peculiarly apposite nowadays. Jesus, the son of Sirach, says: "The wisdom of a learned man cometh by opportunity of leisure"; and he goes on to explain that merely multifarious activities of the more obvious kind are injurious to such a man, since they hinder and distract him from more worthy tasks, and prevent his accomplishing what is truly worth while. For this, tranquillity is needed, and the depth that comes from prolonged and undisturbed concentration. This is an essential condition for the work of investigation; activity is useless unless properly directed; but direction requires thought; and thought requires time for thinking—which is leisure. Wordsworth says very profoundly in "Laodameia":

> . . . The Gods approve
> The depth and not the tumult of the soul.

I do not know of any more suitable motto for a university than just this. For, after all, it is depth we want; and no degree of external activity, however effective or apparently beneficial, can make up for its lack. But how can it be gained without leisure—freedom for thought and study and research, and belief in their efficacy and saving grace? Such freedom is the source of all spontaneity and originality. You all remember how, when an admirer expressed his delight over the perfection and inevitability of a line of Tennyson, and said he knew *that* was a pure stroke of inspiration, the poet replied: "Well, I smoked three pipes over that line." Now it may be that not all affairs can be conducted in that way; we in the universities should recognize this and not be disturbed by it, while maintaining, nevertheless, that our ways are different. We form a sanctuary for all those who, whether by smoking pipes or otherwise, can by the power of thought, and activity directed by thought, attain the essential truth in any matter. I do not speak here of the beautiful; that is the realm of art. But in scholarship what is essential is *ideas;* it is these which give value and interest to the often dry details of investigation, and which guide and inspire the work of gathering fresh detail. We find that if we have the ideas we can usually test their validity without great difficulty; but they are the indispensable, and we can not get them without thinking and studying deeply. For that we require leisure. I dwell on these considerations because there is little doubt that our day and generation does not sufficiently recognize the need of leisure in academic life, and often misunderstands its purpose. Yet it is essential that there should be an atmosphere of leisure—of freedom from external compulsion—in the universities, if they are to be fully and adequately productive in original scholarship. We must understand clearly the purpose of such leisure, which is simply to afford opportunity—not for idleness, as I need hardly say, but for fruitful independent effort. In this sense leisure should be the chief prerogative of the educated man everywhere. It really implies nothing but freedom, and for its proper use both discipline and high purpose are needed. The knowledge and the will to use freedom rightly—surely these are what all who are truly educated ought to have; and we must be willing first of all to assume that those who are entrusted with the tasks of education and the advancement of learning are

especially fit to be entrusted with their own freedom. It is likely that an enlightened society can be relied on to recognize this; but it is particularly the duty of the universities, if they believe in their own best traditions, to speak with no uncertain voice. We look chiefly to them for progress in those fundamental fields of knowledge which ultimately concern more intimately than any others the future of civilization; and if they are to continue their leadership they must show that they value above all immediate advantages the tradition of academic freedom.

Ralph S. Lillie

Clark University,
February 1, 1914

## *The National Academy of Sciences*

The Academy will hold its annual meeting at Washington on April 19, 20, 21, 1915. The program is as follows:

MONDAY, APRIL 19

10 A.M.—Business meeting of the Academy in the Oak Room of the Hotel Raleigh.

1 P.M.—Luncheon in the private dining-room of the Hotel Raleigh.

2.30 P.M.—Auditorium, National Museum. Public scientific session:

Thomas H. Morgan: "Localization of the Hereditary Material in Germ Cells." (30 minutes.)

Problems of Nutrition and Growth:

Jacques Loeb: "Stimulation of Growth." (30 minutes.)

Lafayette B. Mendel: "Specific Chemical Aspects of Growth." (30 minutes.)

Eugene F. Du Bois, medical director, Russell Sage Institute of Pathology (by invitation of the program committee): "Basal Metabolism during the Period of Growth." (30 minutes.)

I. S. Kleiner and S. J. Meltzer: "Retention in the Circulation of Injected Dextrose in Depancreatized Animals and the Effect of an Intravenous Injection of an Emulsion of Pancreas upon this Retention." (10 minutes.)

5 P.M.—Meeting of the editors of the *Proceedings*, Cosmos Club.

8 P.M.—Auditorium, National Museum.

First William Ellery Hale Lecture, by Thomas Chrowder Chamberlin, of the University of Chicago. Subject: "The Evolution of the Earth." (Illustrated.)

The lecture will be followed by a conversazione in the Art Gallery of the National Museum.

TUESDAY, APRIL 20

10 A.M.—Auditorium, National Museum. Public scientific session:

Joel Stebbins, Draper Medallist: "The Electrical Photometry of Stars." (30 minutes, illustrated.)

George E. Hale: "A Vortex Hypothesis of Sun Spots." (20 minutes, illustrated.)

Edwin B. Frost: "The Spectroscopic Binary, Mu Orionis." (10 minutes, illustrated.)

Robert W. Wood: "One-dimensional Gases and the Experimental Determination of the Law of Reflection for Gas Molecules." (10 minutes, illustrated.)

Robert W. Wood: "The Relation between Resonance and Absorption Spectra." (15 minutes, illustrated.)

Edward L. Nichols and H. L. Howes: "On the Polarized Fluorescence of Ammonio-Uranyl Chloride." (15 minutes, illustrated.)

Robert A. Millikan (by invitation of the Program Committee): "Atomism in Modern Physics." (30 minutes, illustrated.)

1 P.M.—Luncheon in the Oak Room of the Hotel Raleigh.

2.30 P.M.—Auditorium, National Museum. Public scientific session:

William Morris Davis: "Problems Associated with the Origin of Coral Reefs, suggested by a Shaler Memorial Study of the Reefs of Fiji, New Caledonia, Loyalty Islands, New Hebrides, Queensland and the Society Islands, in 1914." (60 minutes, illustrated.)

F. W. Clarke: "Inorganic Constituents of Marine Invertebrates." (15 minutes.)

Roy L. Moodie (introduced by Henry Fairfield Osborn): "Amphibia and Reptilia of the American Carboniferous." (15 minutes, illustrated.)

Henry Fairfield Osborn and J. Howard McGregor: "Human Races of the Old Stone Age of Europe, the Geologic Time of their Appearance, their Racial and Anatomical Characters." (15 minutes, illustrated.)

Charles A. Davis, geologist, Bureau of Mines (by invitation of the Program Committee): "On the Fossil Algæ of the Petroleum-yielding Shales of the Green River Formation." (15 minutes, illustrated.)