SCIENCE

FRIDAY, APRIL 24, 1914

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THE PREDICAMENT OF SCHOLARSHIP IN AMERICA AND ONE SOLUTION[1]

WHAT is scholarship? The answer is: The discovering, the organizing and the explaining of new facts. Only the uninformed and unscholarly are in the habit of designating the mere diffusion of knowledge as scholarship. The man who merely reads and speaks what he reads is no scholar, nor is the man a scholar who merely requires others to study what is already known. Any nation that believes only in the diffusion of knowledge is on the road to decay. But it is not my purpose to prove the generally accepted notion that productive scholarship is the only scholarship. We must, however, agree on the value of scholarship or the argument in this paper can have no importance. That no one may say that our subject is idle talk, I want to say, I believe for any nation that has any hope of perpetual existence that the scholars are the most essential of any class of society. And may we postulate, for the sake of the argument, that God will not provide and take care of the scholars?

And what is the predicament of scholarship in America? Simply this: That the institutions that have attempted to foster scholarship have not lived up to their opportunities. We may inquire into the reasons later. The one solution that the author proposes is to establish a new and higher institution, whose sole purpose would be to promote scholarship, and thereby furnish a new inspiration to educational, industrial and private establishments.

[1] Read before the Outlook Club of the University of Iowa at the February meeting.

I shall confine my arguments to the one field of scholarship with which I am most familiar, and trust that my readers who are most familiar with other fields will notice the close parallelism to the predicament in physics. And perhaps to those also a solution similar to the one here proposed will seem advisable.

To avoid any tone of pessimism, the views of the author will be presented in a constructive way, with the subject-matter, a plea for the physical institute in America; this institute to serve scholarship in physics much as the physical institutes of the German universities, the Royal Institution of England or the Cavendish Laboratory at Cambridge serve scholarship.

America has not led in thought since the days of Franklin. America follows thought. Consider some of the recent achievements in physical science; X-rays and their nature, Hertzian waves, liquid air, liquid helium, cathode rays, positive rays, radium and radioactive bodies, alpha rays, beta rays, the construction of matter, the photo-electrons, the theories of radiation and of fluorescence, the relations of heat conductivity to electrical conductivity. These and practically every recently proposed fundamental principle and important discovery in modern physics has come from abroad. But it is not necessary to make any apologies in behalf of Yankee ingenuity. I am speaking only in behalf of basic knowledge.

A PLEA FOR THE PHYSICAL INSTITUTE IN AMERICA

In making a plea for the physical institute in America I am making a plea for greater efficiency in the development of pure science in this country. It is believed that the time is overripe for the segregation of a small group of the ablest scholars in experimental and theoretical physics, who shall have all the inspiration of close association with scholars in like work, all the facilities that an immensely wealthy country can provide, and who shall be free from the routine work of clerical management or the routine of teaching of disinterested or incapable students. The argument is simple and it is believed irrefutable, and is presented without in the least minimizing the value of a scattered scholarship for the general inspiration of a student body and the general public.

The time is believed to be overripe because we are spending more money on higher education per capita than any country of the globe, and at the same time it would be bold to claim a second-rate place for ourselves in the development of pure physical science. The situation generally in our universities is such as to discourage the development of capable and promising young men by management that encourages faithfulness to second-rate ideals. We are already on the verge of an over-production of zealous and promising scholars, who can see no future other than that of servitude in the small college or with detail or clerical work in a laboratory swarming with students. Admit if you will that it is all good work and also that the soul must do penance, nevertheless the bright and capable young man, even if he has a vision, insists on looking ahead to a life of respectability and achievement with an ultimate freedom from the worries of the things of life.

Our commercial enterprises are just discovering that much of this ability can be easily and most profitably adapted to the advancement of applied science. And it must be said to their credit that they already bid fair to surpass most of our universities in pure science, even though their ideal is admittedly to make scholarship pay in the near immediate future. The

wonderful success of some of our commercial research laboratories should furnish a genuine stimulus to those of us who believe in greater opportunities for pure science. Of course if we should not believe in a scholarship in science which is not hampered by questions of immediate rewards, then there is no occasion for the plea in this paper. A discussion of the organization and the scope of a working institute can best be given after we have first analyzed somewhat in detail the existing conditions which are manifestly not as efficient as they should be. And lastly, we should be in a position to outline a tentative plan for the development of the organization.

THE SITUATION IN OUR UNIVERSITIES

The idea of the physical institute is to supplement the work of our universities by founding a higher standard and furnishing a new source of inspiration. True enough, our universities have sufficient resources to properly foster the work of a physical institute, and there is an abundant supply of men forthcoming. Moreover, they believe in general that productive scholarship is the most important function of a university and it is agreed that genuine scholars are of the most rare and difficult type to develop. But the difficulty with our universities is one that arises from mixed ideals, particularly in our state universities. The ideal of competition perhaps takes precedence of all other ideals in practise, and along with this is associated the ideal of efficiency in detail management of students. Surely a university wants scholars, but it wants a large number of students first. It wants more students in order to convince the people of its greatness, so that it may get more money so that it may establish more departments, and so get more students, and so on. It must do extension work so that the work of scholars may reach every citizen of the land within a few days after it has been accomplished. Energy and resources that might be directed toward scholarship are scattered in every direction that human imagination can conceive of. The ideal in practise is not how great scholarship, but how thin can it be spread. In other words, there is in our scholarship a strong tendency toward democracy gone mad. Now if only one side of the situation in our universities is emphasized, may it be remembered that the author wishes to make clear a difficulty which can be side-stepped in one particular by the organization of the physical institute. Of course the administrative authorities of most universities would remind us that they are building for the future. Their ideal is service in a broad sense. Scholarship first in so far as it is first in service to the immediate mass of humanity. Scholarship for the sake of scholarship—never! But if we will admit the result of the recent investigations of Professor Cattell, which is that our administrative officers generally can have no vision of the value of scholarship to the future of society, we can proceed with our argument. The argument of the administration against scholarship is much like that of one farmer toward the education of his son. No, no, my son, you must stay out of school a few years and safeguard the future. We will raise more corn and feed more hogs, so that we can buy more land, and raise more corn, etc., and by and by you can go entirely through the university and take your brothers and sisters along if you yet have the desire.

The predicament of the state universities is well stated by Professor Geo. J. Peirce:

> The masses of a democracy recognize present wants more surely than they anticipate future

needs. They require an immediate supply to meet an existing demand. They consider a state university to be well fulfilling its function if it furnishes such a supply. . . . But the wholesale business of the state university limits if it does not prohibit that attention to the exceptional student which may result in training a leader of his generation, a seer who, divining the future needs of the state, may begin to prepare to meet them, a man who, profiting by the recorded experience of the past, may mold as well as meet conditions.

And what has been the result of the material growth of our universities on the development of physical science in this country? We have laboratories of marble and cases filled with apparatus, and hordes of students, and a wonderful machine-like system to care for these students. But the efforts and resources adapted to scholarly purposes are not at all in proportion to merit. Even now we are confronted with a difficulty which shows us the need and opportunity of concentrating our efforts toward scholarship. Every year we have young men of good promise who either can not find positions at all in our universities, or who are compelled to take positions with such requirements and surroundings that the development of the individual is practically impossible, and at the same time every year the universities can not find enough mediocre men at salaries ranging from $600 to $1,000. The demand is for men who will take care of these hordes of students, men who will lead these students by the hand and feed them with a spoon, men who will set up elementary experiments, grade notebooks and daily examination papers, and correct English, and who thereby make parents and patrons believe that everything is moving along smoothly and efficiently. For if the students do not appear to be busy the institution will get a bad name and the number of students will not increase. And what can be worse than an idle student body or a lack of increase of students. It is no doubt true that in some instances scholarship is not developed in physics because the members of the department staff are beyond hope of becoming scholars and they either have no knowledge of what tends to develop scholarship or are afraid that some individual might develop who would be a greater man than those on the ground floor. But this latter is pure hypothesis.

What is needed is a higher light on American soil. Too many professors are satisfied to spend their time making out and mimeographing notes and examinations, and even making apparatus, or in conferences with the laggard students, or perhaps with unimportant committees. Sometimes they do not realize how poorly they invest their time when they are merely reading and becoming informed, as it were. Frequently professors keep themselves so busy with labors like the above and even such cheap labor as dusting apparatus that they do not have time and energy left for the merest semblance of thought. Productive scholarship is the flower of our educational work and that individual who shows tendencies to bloom should be allowed the every ounce of his energy to apply in this direction.

I believe it is not fair to blame the ruling bodies of our institutions too much, for they are merely the creations of a complex set of circumstances in our overemphasized democracy. Men with ideals when in power find themselves faced by situations which seem to require a single line of procedure in order to preserve any semblance of power. The reader will please not understand that our universities are devoid of good administrators, or that scholars are unknown. Moreover, there are evidences of forces at work for the improvement of our administrative methods in the universities, and there are urgent appeals for the improvement of scholarship. But I be-

lieve that the progress can be made more rapid, and that scholarship in theoretical and experimental physics can be more quickly put where it should be by the development of a new and higher institution, which shall be largely unhampered by the accustomed administration and students of our universities.

And I can not proceed further without saying a familiar word about our students. The students in our universities may be divided into three classes, as follows: those who early in their university career think they know how they wish to function in society and who remain in the university primarily as an aid to carrying out serious purposes—those who attend the university for a pleasant life and ultimate social standing primarily, who, like Micawber, trust that something will turn up—and those with a serious desire to specialize in some line of human activity after they have obtained some notion of the relative merits of the various classes of activities and their own fitness and interest.

Those of the first class constitute a large portion of the students of our professional colleges. The average brightness and capability of this class is very good. Perhaps this is because of the definiteness of procedure, and the assurance of a life of comfort and respectability. Perhaps some are afraid of being classed with the non-serious, purposeless ones and again some do not trust themselves to a broad career with its many chances and pitfalls.

The second class are the most numerous generally. They sometimes study elementary physics, and they usually get some good as a result of their sojourn in the university. No doubt the average of society is raised. Some who come to scoff remain to pray. The only objection to this class of students is that they are not worth their cost. Of course they can not be eliminated because of the difficulty of discerning who belongs to this class and because of the political dangers. The students of the third class are all too few in number, and of this class the contamination by the other classes is so great that the net weight is frequently vanishingly small. From this third class we should draw our scholars in all fields of pure science and the humanities, our artists, our administrators in many fields, including senators, representatives, college presidents and leaders, wherever there is a fight between the old and the new, because forsooth these men should view human activities in the broad sense, and therefore should recognize what efforts conform to the development of society and the universe.

Now the great criticism that a physicist in particular may bring against our universities is that the cream of the time and energy of the university professor is taken in contact with students of classes one and two.

THE SITUATION IN OUR INDUSTRIES

And what is the situation in our industries that we should declare that it is impossible for industrial research laboratories to properly develop science, no matter how much wealth and energy they may expend for investigation. In order to answer this question we may inquire into their ideals and methods, their resources and their achievements.

The ideal in our industries is admittedly investigation that pays, *i. e.*, investigation for a useful purpose. Now, as Dr. Whitney points out, the pay comes in two directions—one in returning more dollars and cents than is invested in the research laboratory, and, secondly, in maintaining the practise of the manufacturing concern by being ready to cope intelligently with any other concern that may attempt supremacy as a result of new discoveries. It may be unfair to pronounce upon the question as to whether there is a soul in a commercial enterprise that leads it to desire to achieve

for no other reason than to keep its name and its work preeminently on the map throughout the ages. Perhaps this latter phase of the ideal may exist even though its workers may be largely unaware of it. At any rate, I believe it is generally admitted that it is desired that material rewards shall be forthcoming in the near future. If it could be that wise leaders in industrial research could recognize the value of pure science to the industries centuries hence, then there would be not so urgent a plea for the physical institute. But these concerns are of human hands and in a democratic country, and the resources generally come from individuals who expect dividends at least in due time to be incorporated in the death wills of the stockholders. I believe that as a corporation grows large it tends toward the recognition of values other than immediate money values. If so this is cause for larger faith in humanity. In fairness we must also recognize the struggle for corporate existence the same as we recognize the struggle of the individual. It is, for example, perhaps difficult to know to whom should be given credit for the establishment of such able and broad-minded leadership as prevails at the General Electric Company's laboratories.

The pure scientist believes that it is most difficult to obtain willing and capable men who will devote all their energies to the search for new knowledge by the free and methodical movement of the human mind, without regard to practical applications and money rewards. He believes further that this is the only royal road to intellectual achievement, and yet he is not unmindful that some time or other much of the knowledge will be absolutely necessary to the existence of the human race. He believes that the man who investigates with a commercial purpose in view has a handicap load that must limit him in his arduous search to the extent that such an investigator can only be half a scientist.

The attitude of the commercial scientist may be gathered from the words in part of Dr. Arthur D. Little in his recent presidential address before the American Chemical Society:

> Most of us believe that the doctrine science for science's sake is as meaningless and mischievous as that of art for art's sake or literature for literature's sake. These things were made for man, not for themselves, nor was man made for them.

The pure scientist is perfectly aware of the immediate value to humanity of this attitude, but at the same time he insists that there should also exist a body of most capable thinkers who shall not be limited by placing dollar signs ahead to mark out the paths. Even from the standpoint of service the dollar mark often leads away from the best route or the safe route. For what man of Faraday's time could have predicted that within a century the electrical industries of one country would be facing a capital requirement of $8,000,000 a week.

That research pays our industries acknowledge fully. They are aware that in farming alone investigation has resulted in the saving of about $1,000,000 in the labor cost of a single crop and a very much larger saving as a result of increased yield, as compared with fifty years ago, or that in electric lighting alone fully the same sum has been saved annually as a result of the progress in the last ten years. And I doubt if it could be estimated the returns that have come to the steel industry or the telephone industry as a result of their years of special researches. According to Dr. Little there are several industrial firms that are now spending $300,000 annually on their research laboratories, and many more, $100,000 a year. These figures should certainly make those interested in the promotion of pure science take notice. It is perfectly obvious that it is a concentration of effort and resources of our much-talked-of trusts that has made possible these wonderful expendi-

tures and the advances which have followed. As a result of cooperation of several firms we have the National Electric Lamp Association Physical Laboratory at Cleveland, which perhaps approaches more nearly to a pure-science laboratory than any that are fostered by the industries. But this laboratory can not divorce itself from the interests that nourish it. Its investigators will naturally have regard for problems which seem to bear on the industry.

Also there is the Bureau of Standards, whose good work is so well known. This bureau spends annually about $700,000. But the spirit of this institution is toward the refinement and the standardization of the best that has been or about to be accepted in the scientific world. The scientists of this bureau are in a sense the conservers of scholarship. It is only occasionally that they expend energy toward the development of pure physics. They find plenty to do in the field they have chosen. It is very doubtful if this organization with its congressional control and red tape would be conducive to the free and easy movement of the human mind in scholarly productions.

In this connection the opinion of General A. W. Greely is worthy of note, which is:

> The failure of our government to properly recognize scientific work appears to be due to an antiquated and inherited policy, which must be to the ultimate detriment of the common weal. This year the attention of the government has been urgently called to the untoward conditions, arising from illiberal treatment of expert officials. Distinguished chiefs of several important national bureaus officially report increasing difficulty in maintaining an efficient scientific staff. Unusual and steadily increasing numbers of scientists and experts are accepting commercial positions in order to meet the enhanced cost of living.

THE ORGANIZATION OF THE PHYSICAL INSTITUTE

The organization of the physical institute should be such that a few of the greatest world physicists could be induced to join it and remain with it. The things that such a man needs are freedom from cares concerning food and shelter, livable surroundings, human associates who are interested in like work, and freedom from petty administrations, and perhaps the last two would be most effective in retaining men and keeping them effectively at work. Our universities and government bureaus frequently furnish the first two requisites, but seldom the last two. If any furnish all four, I shall let those who know say it.

The first condition would perhaps be filled satisfactorily if the physicists could have a salary of $10,000 each. The surroundings should be a laboratory fully equipped, situated preferably in some quiet spot and beautiful and within easy reach of some metropolis. Nearness to some large university would also be helpful.

The associations would be partly supplied by the other men of precisely equal standing at the laboratory, but this would not suffice for the men or the cause. There should be a number of fellows of standing about equal to that of our best new doctors of philosophy. They should obtain stipends of about $1,500, and should be allowed to keep these appointments for as many years as they see fit, of course devoting their time to research, with all the aid that they can obtain from the honored physicists, or honored professors, if you prefer. Also there should be as many students in theoretical and experimental work as the honored professors might wish to accept.

The administration should be entirely in the hands of these professors, who may elect a qualified secretary to take care of the routine business management. Any new appointments to the professorships or fellowships should be made only in case of

deaths or voluntary removals. No alteration should be made in the salaries or the essentials of the organization except by unanimous vote of the administration. The institution should be conservative, so that there might be no occasion for troubles and so that there might be ample time to test the ideal of the laboratory.

The institution should have the power to confer a special honorary degree on any man of the institute or elsewhere for preeminently noteworthy work in physics. This degree should bear no relation to the period of service of the candidate. This would aid in giving the institute a rightful leadership in scholarship.

An American institute for physics with the ideal for scholarship alone, should be fostered by private endowment, by a governmental bureau or by a national university, but hardly by any university such as exists already. A private endowment would be preferable from all points of view save perhaps one, providing of course that no strings were tied to the endowment inconsistent with the ideals of the institution. A privately endowed institution might not tie itself up with our nation and our existing educational institutions as fast as if it were otherwise fostered. And yet the success of the Rockefeller Institute for Medical Research would tend to dispel this notion. The capitalization need not be beyond a private endowment, for the income could be less than that spent by many industrial concerns on research, but of course more than spent by most universities for research.

A governmental bureau might foster such a project if it could only have a charter that would insure it a semi-permanent freedom from disturbances arising from the petty rules prevailing generally in our governmental bureaus. Such an action by our government would create a tremendous sentiment in favor of scholarship throughout our democracy. It is not unreasonable to expect that national support of scholarship would create a national spirit somewhat like that in Germany, for it is well known that the government there has long fostered scholarship and that German industrial supremacy has come as a result of supremacy in productive scholarship. According to Professor Mann, Germany has established a separate lot of schools to take care of the technical education which our state universities feel called upon to provide for.

The government might cooperate in a physical institute somewhat on the basis of the work done by the Carnegie Institution. Already this institution serves purposes closely akin to those of the proposed physical institute, particularly in geo-physics and in terrestrial magnetism, and yet there are obvious distinctions.

A national university might foster a physical institute properly, but there are grave doubts. It is not clear how such a university could be founded on federal support without the injurious meddling of the demagogue, who can not recognize any good to society that is not certain to extend to the masses in the present or near future generations. The attitude of Willet M. Hays, for example, who holds that a national university should reach ninety per cent. of the people in the present generation, may be all right for a technical school or high school, but this attitude should be regarded as positively vicious when applied to a national university. As the Assistant Secretary of Agriculture points out, already applied science is developing much faster than pure science. My opinion is that this only emphasizes our great need for institutions that shall develop leaders and prophets. Such an institution could, if properly chartered, in-

corporate a worthy physical institute. And this institute could pilot the way in those things that pertain to the development of physical science. A reasonable number of promising sudents would furnish working material for the honored professors, and later they would spread the gospel.

The publication of the work of such an institute would be a matter of detail and one that would take care of itself. I believe that a suddenly created national university with the proper ideals is an almost Herculean task. However, if several institutes of the character of the proposed physical institute could be founded one by one, these could later form a loose union for cooperation without waste of energy or loss of spirit.

If my readers are inclined to admit the strength of the argument in this paper when it is considered in connection with the efforts of our state universities, but not when considered in connection with our endowed universities, they should be reminded that the latter type of institution has not succeeded in retaining such physicists as Rutherford, Jeans, Richardson and Maclaurin. Other foreign physicists have even declined to try our atmosphere. Our self-respect demands that we attempt to create one center of physical research to which eminent world physicists would be willing and happy to come. I believe that with the establishment of the physical institute we should soon have the spirit, intelligence, work and courage of the American university professor in physics raised to such an extent that men would be honored with salaries as well as with ranking titles, such that the fellowship of students would mean inspiration rather than a deadly burden, such that irregular administrative management would not be tolerated, and such that a correct public sense of values would be established.

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THE NEW MECHANICS

IN the past decade, rumors have become current that physicists were attacking critically the ideas which have been accepted in mechanics since the time of Newton. Articles have appeared which assert that there are two mechanics, the Newtonian or classical, and the non-Newtonian or modern. And it must occur to many to ask whether this is to be a war of words, as has so often resulted from looking at the same thing from opposite sides, or whether we are living in a world perplexed by two rulers, for we have pretty generally submitted to the doctrine that we and the rest of the universe are parts of a mechanical machine. And it would be an additional perturbation, in these already troublous times, to have to decide which governor to live under. While the laws of mechanics will probably be modified, still we are now certain that the changes will not affect problems involving matter in any of its ordinary aspects. The human race, in its present state of existence, will thus continue to conform to the laws of Newtonian mechanics; but we must be prepared for an early proclamation from Sir Oliver Lodge, the apostle of the science of spiritual mechanics, that death is merely the transfer of those complexes of the ether, called man, to a massive empty space governed by the laws of non-Newtonian mechanics—where our spirits move hither and thither with the velocity of light, and think with an energy comparable to the explosion of an atom.

The real issues of this very important discussion of the laws of mechanics are now fairly determined, and when the Société Française de Physique made them the subject of a conference, no one could have been found better fitted to state the case than M. Paul Langevin, of the Collège de France. Now that his opinions have been published, it is comparatively easy to present the ideas