SCIENCE

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CONTENTS:

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THE CARNEGIE INSTITUTION.

No doubt the officers of the Carnegie Institution fully realize the responsibility resting upon them and will refrain from making any considerable appropriations from the funds placed at their disposal until a well-defined policy, having the approval of the leading men in various departments of scientific research, has been adopted. I take it for granted that the officers and trustees are fully impressed with the importance of using the generous endowment placed in their hands in the most economical manner possible, having in view the objects to be attained—that is, they will aim to accomplish the greatest possible results with the means at their disposal. This will require very careful consideration and very exact knowledge of what is being done by other institutions and endowments for scientific research both in this country and in Europe. To go over ground that has already been well plowed or to undertake investigations for which there is already adequate provision would be a waste of money and of energy. The Carnegie Institution should not come into competition with any existing, well-directed agency for research work, but should be ready to lend a helping hand wherever it is needed for the prosecution of work already commenced or projected by competent investigators; otherwise it will, to a

certain extent, have a tendency to restrict scientific research in other institutions less amply endowed and having other uses for their money. So far as the national government is concerned, there can be no doubt that there would be a strong disposition to refuse or cut down appropriations for scientific work in the various departments if it was believed that the funds of the Carnegie Institution could be made available for such work.

In my opinion a considerable portion of the income should be used in assisting individuals who have demonstrated their fitness for research work in some special field of investigation, who have a definite object in view and well-considered plans for attacking the problem or problems which have engaged their attention. A certain amount of money may also be profitably devoted to the publication of scientific memoirs, and especially of those relating to research work done under the auspices of, or with the assistance of, the Carnegie Institution; also in assisting useful scientific periodicals which are not self-supporting. I would not encroach upon the capital of the Carnegie Institution for the erection of buildings or for any other purpose, but in my opinion a certain portion of the income should be devoted to the erection of a building in the city of Washington which would serve as 'headquarters' for officers and should be known as the 'Carnegie Institution.' This building should contain, in addition to the necessary offices, suitable rooms for the meetings of the various national and local scientific societies which meet in the city of Washington, including committee rooms, etc., also well-equipped laboratories for research work in physics, chemistry and biology.

In laying out the work and distributing available funds I trust that the executive committee will give due consideration to the claims of that branch of biology which relates to the health and well-being of man. No department of scientific research has given more important and brilliant results during the past quarter of a century than that which relates to the cause and prevention of infectious diseases, and there is still much work to be done in this field of investigation. Also in other lines of work which may be included under the general head 'hygiene.' In its broadest signification hygiene takes account of climate, soil, food, clothing, dwellings, occupations and social relations as related to the health and longevity of individuals, communities and nations. Here is a broad and fruitful field which has been partly illumined by the light of science with most beneficent results. But there are still many dark places where truth is hidden from our view or obscured by the acceptance of false conclusions based upon tradition or upon mistaken observation. While pure science may well be pursued without any regard for utility, it is nevertheless true that the most valued discoveries of scientific investigators are those which have led to practical results of importance, and I trust that the officers of the Carnegie Institution will not be disposed to look with disfavor upon the line of investigation in which I am especially interested because the facts demonstrated by scientific methods of research have a more or less direct bearing upon the welfare of the human race.

Geo. M. Sternberg.

In the discussion of the question of the scope of the Carnegie Institution, the chief thing, it seems to me, to be kept in mind, is that the revenues from this foundation should be directed to fields of research not provided for by universities, governments or other endowments. It is not so much 'what should be done' as 'what is not doing.' Lines of research which are not now

followed should receive first attention. In every branch of science is found a great unknown, an unexplored desert. Into these regions scientific research should penetrate.

The income of the Carnegie Institution is indeed large, but small when compared with the sum of private, public and governmental endowments of scientific activity in this country.

It may be assumed that the Carnegie fund will yield a half million dollars of available money annually. This is only a little more than one third of the income of Harvard University ($1,416,000), although the endowment of that institution is only about three million dollars greater than the Carnegie gift ($13,120,000).

The appropriation for the Bureau of Standards for the present year is $71,060; for the Coast and Geodetic Survey $828,525; for the Geological Survey $1,066,570; and the total appropriation for the Agriculture Department is $4,488,960 not including $720,000 for the agricultural experiment stations.

The total income of the agricultural colleges from the Land Grant endowment for the fiscal year ending June 30, 1901, was $708,010.45, and from the direct appropriation from the Federal Treasury ($25,000 for each one) $1,200,000. These colleges received from the several states $3,683,162.34 and from tuition and other fees $1,777,069.11, making a total income of the agricultural colleges of this country $7,386,241.60. The agricultural experiment stations received during the same time from the Congress of the United States $720,000, and from the several states and other sources $511,881.55, a total of $1,231,881.55. Of all this sum, amounting to $15,055,238.15, it is safe to assume that fully one third is devoted exclusively to scientific purposes—a sum ten times as great as the total income from the Carnegie fund. In this total no account is taken of the great endowments, public and private, to foster scientific research and activity in schools, colleges, universities and technical institutions.

It is seen from the above figures that the trustees of the Carnegie Institution will find a keen competition if they undertake any line of investigations already carried on under the auspices of the Government. In fact, I may be permitted to say here that the greatest danger, in my opinion, which now threatens the value of scientific work of the Government is a plethora of available funds. The best work of this kind is not necessarily done with access to unlimited supplies, and the *res angustæ* which compel a certain inventive ability to make both ends meet are sometimes highly useful in scientific research. The one mistake therefore which the trustees of the Carnegie fund will be certain to avoid is the granting of such bounties as will foster that hebetude which springs from satiety. If science should descend to the mere plane of a money maker it would then be time to form a trust to limit all activity and confer the revenues upon a chosen few. But that day is, happily, yet far off.

It appears to me that the life of the nation and its normal growth are the problems of supreme importance. Geography, soil, climate and race have conspired to make this nation the ruler of the world—far more powerful than le Tocqueville and Creasy ever imagined.*

Whatever our individual beliefs may be our nation is committed to hold the first place. We are powerless in the path of destiny. This means not only the political hegemony which is inevitable but also the physical force which that leadership implies. In this direction lies a field which the Carnegie trustees will find fer-

* See battle of Saratoga in Creasy's 'Decisive Battles of the World.'

tile. We need a fundamental inquiry into explosives as to both energy and stability. All means for the sudden destruction of life in battle should be of the highest efficiency. The engines of war should have the power and suddenness of a Mount Pelée. Especially our navy should be the strongest and most efficient of any in the world.

Of even pace with this development of destruction should be progress in the art of healing wounds and of preventing disease, since the greatest proficiency in war goes always hand in hand with the highest humanity.

Two of the great problems of a great nation are education and taxation. In these lines we want to get out of party and sect and lay deep and broad the foundations of true didactics and just taxation. The tariff should not be a political question and the farmer should not pay more than his share of the taxes, as he does at the present time. In education are included those problems in psychology which you so lucidly set forth in your paper.

Intimately associated with the problem of the nation's life is the question of alcoholic beverages. Where could be found a more promising field for investigation than in the discovery of the best way to avoid those awful miseries which the abuse of intoxicating beverages produces?

War, healing and avoiding disease, education, taxation, the unregulated use of alcoholic beverages, seem to me to be fields of research in which the Carnegie Institution might find almost an illimitable source of activity.

The art of war in its highest development is peace. Healing is health and long life. Education based on truly scientific principles is power. Taxation which is just and generous is resource. The use of alcoholic beverages properly conditioned is temperance. Peace, health, power, resource and temperance are the attributes of the ruler among the nations of the world.

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The side which appeals most strongly to me in connection with the development of the Carnegie Institution is the granting of research scholarships under the direction of existing laboratories. Mr. Carnegie's original intention in his Scottish University endowment was to render a liberal education possible to every Scot. It seems to me that the many scholarships made possible by Mr. Carnegie would permit of opportunity for research work by a great number of individuals desiring to do such work. The work would be valuable if its supervision were competent. To be a Carnegie research student might become a mark of honor and dignity. I would divide the scholarships into two classes: first, those receiving $1,000 a year devoted entirely to research, and second, those of $500 a year where half the day is devoted to research and the other half to college work.

The great and almost insuperable difficulty in this matter lies in the choice of laboratories to which these scholarships are to be allotted. It is practically impossible to avoid favoritism. The estimated value of work done lies in the current impression even though that may be full of error.

The scholarships should be allotted to laboratories the heads of which have shown themselves competent to do research work. It is a mistake to compel men, who are presumably competent, to reveal an outline of the subject to be investigated. The greatest discoveries are often accidental observations made by trained minds. The former product of their laboratories, or of their personal work, should be the crite-

rion. In this way if one line of investigation seems fruitless, the scholar can at will be turned in another course. Thus the Carnegie Institution may endow but not control the course of science in San Francisco. There must be no limitations to the 'akademische Freiheit.'

In my own laboratory I have always told my students, 'everything will be bought for you and all your breakage will be charged against the laboratory, if you will only give your time to the work.' It is the time of those capable of working which is the laboratory's most valuable asset. Would not scholarships, properly placed, liberate for higher uses the maximum of capable educated endeavor?

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IN response to the request for the views of American men of science on the mission of the Carnegie Institution, I would first of all express the hope that the trustees will reject those propositions which would most seriously menace the free development and untrammeled activity of our various scientific bodies and institutions of learning—especially the establishment of a huge reserve fund, with the annual distribution of its income among the 'deserving poor.' It seems to me that, while there may be occasional demands for large sums to equip exploring parties on behalf of some of the descriptive sciences, the legitimate demands for assistance in research in the exact sciences ought not to be very large, in any one year; in fact, I venture the assertion that the existence of large sums to be devoted in this way might lead to wastefulness in methods, rather than to the development of that resourcefulness which has been the characteristic of the greatest investigators. Favored beneficiaries might choose a field of work from which others would be debarred by questions of cost, rather than strike out upon lines of greater originality and importance. Again, it cannot be denied that the establishment of a standard of measurement with the utmost precision is a work well worthy of national support: but if the Carnegie Institution were to encourage, by means of its stipends, all our most capable physicists to devote themselves to this class of work, advance in this department of knowledge would be seriously hampered. Is it a hardy prediction, however, that the votes of a committee on distribution would always favor such definite projects, as against a proposition to explore some vaguely defined problem of physics or chemistry?

I think, therefore, that the proportion of the income to be devoted to the immediate subvention of research ought to be small at best; the aid would probably be more efficient, if administered through existing scientific societies, who would receive from time to time such additions to their research funds as would seem commensurate with their previous success in promoting investigation. The existence of a central reviewing body would act as a wholesome restraint upon these smaller scientific bodies, while the relative needs of investigators could be better judged by a jury of experts in their immediate field of work, than by such a heterogeneous committee as would be furnished by the trustees themselves.

On the other hand, the suggestion that the institution should play the part of a private benefactor to our universities, by adding to their endowment, building and equipping laboratories, augmenting professors' salaries or providing them with private assistants, seems to me to savor of paternalism and to open the way to serious abuses, while at the same time it might cause colleges to shape their course with the sole view of pleasing the guardians of the fund, for the time being.

It seems doubtful whether any salary could be paid to a body of academicians, sufficient to enable them to devote their whole time to research; and it is a fair question whether it would really be desirable to set a body of men apart in a scientific academy, at the present day, without that contact with students which a university provides. It must be remembered that the Royal Institution of London is not an academy in the strictest sense; nor do the resident lecturers owe a duty to a foundation, but rather to the subscribers. With the enormous distances separating our educational centers, it would not be conceivable that a lecturer could assemble around him so national an audience as would listen to a Faraday or a Rayleigh.

All these plans remind one of the hothouse method of stimulating plant-growth; why not attempt the open-air method of cultivating the soil? The Carnegie Institution might facilitate research for all, instead of offering incentives to a chosen few. For this reason, the satisfactory equipment of marine biological stations, open to all qualified observers, and of similar institutions that would render the natural phenomena more readily accessible to general study, would seem eminently proper; while one might doubt the propriety of establishing observatories simply for the intense study of single problems. The efficacy of special research laboratories in the physical sciences, such as England owes to the generosity of Mr. Mond, has yet to be proven in contrast with that of university laboratories; to the writer, their establishment in this country would appear premature, since many of our well-equipped educational laboratories are not so crowded that they would be obliged to refuse accommodation to an independent investigator who sought their hospitality.

The same general argument would oppose the financial support of periodicals and publishing organizations, while it would strongly favor the equipment of a scientific printing office, for the prompt and cheap reproduction of the results of research, for the account of individuals as well as of associations. However, if the trustees desired to obviate the most serious difficulties which beset the American scientist in his laboratory work, they would establish workshops for the construction of special apparatus and the preparation of the more recondite materials, such as rare chemicals, microscopic mounts, etc. What stipend, for instance, could put the American chemist on a level with his German colleague, when the latter can obtain, within twenty-four hours, any preparation that is catalogued, while the former must allow six weeks for obtaining anything that is not so commonly known as to be literally a 'drug on the market'? By enabling the private investigator to supply his needs quickly and at reasonable cost, without the unjust discrimination of 'duty-free' importation, a stimulus would be given to private research, inside and outside the college laboratory. Who can estimate the amount of time frittered away in this country through the lack of ready access to the mechanical adjuncts to investigation? Workshops to supply these would not only improve our immediate condition; but, if properly organized, they might serve to educate a body of mechanicians and preparators, whose help would be invaluable in the various scientific institutions of the country.

If these suggestions should illustrate the view that the Carnegie Institution can do measurable harm by seeking to supplant private initiative with artificial stimulus, but can do immeasurable good by clearing away the obstacles that now trammel the general growth of the scientific spirit in America, they will best express the opinions of

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