

**THE  
ENDOWMENT  
OF  
SCIENTIFIC  
RESEARCH**

**RICHARD A. PROCTOR**

1875

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# **THE ENDOWMENT OF SCIENTIFIC RESEARCH**

**BY RICHARD A. PROCTOR**

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### **About the Author:**

Richard Anthony Proctor (23 March 1837 – 12 September 1888) was an English astronomer. He is best remembered for having produced one of the earliest maps of Mars in 1867 from 27 drawings by the English observer William Rutter Dawes. His map was later superseded by those of Giovanni Schiaparelli and Eugène Antoniadi and his nomenclature was dropped (for instance, his "Kaiser Sea" became Syrtis Major Planum).

Source: Wikipedia

# The endowment of scientific research

## Part I

THERE are questions admitting, when viewed in the abstract, of but one answer, which yet, considered in their practical aspect, present difficulties that are almost, if not wholly, insuperable. Among them must be reckoned one which before long will attract, as it preeminently deserves, the attention of the nation—the question whether it is desirable that the investigation of natural facts, regarded as a vocation, should be publicly endowed.

When I say that but one answer can be given to this question, viewed in the abstract, I draw two distinctions: 1. I consider only the question whether science deserves public recognition; and, 2. I suppose the question submitted only to those who can properly consider it—those, namely, who are at least acquainted with scientific methods, if not versed in scientific subjects. To many it may probably appear a matter of small importance whether science advance or stand still. The general public scarcely recognizes the position which Science has already taken, still less the position she is about to take. Men do not perceive that the gradual advance of science must modify the condition of the human race, not in material matters alone, but even more by its influence on the feelings and emotions. In the course of time—and of no very long time, if future progress accords with present promise—the motives now most potent among men will yield to worthier influences, arising from clearer insight into physical, physiological, and psychological laws. Science, using the word in its best sense, has now a limited extension; but it is as a leaven in the midst, by which the whole lump will be leavened. In the mean time, men attend, as of yore, to matters which they regard as far more important than the growth and spread of knowledge—matters which have made up the history of the nations during many centuries, but have tended little to the advancement of mankind. Political plotting and counter-plotting, within each nation and among different nations; the preparation and employment of armaments thus rendered necessary; legislation by which class distinctions are strengthened and class dislikes intensified; the working out of social arrangements barbaric in origin and absurd in most of their developments; controversies over religious questions more or less closely associated with primeval superstitions—these and such as these are the occupations to which the world mainly devotes the energies

not absorbed in the general struggle for existence. Science, in the mean while, conscious of its strength and certain of its future, can afford to wait, "Its development," as Tyndall has well said, "is as necessary and irresistible as the motion of the tides or the flowing of the Gulf Stream. It is a phase of the energy of Nature, and, as such, is sure in due time to compel the recognition of those who now decry its influence and discourage its advance."

That science is worthy of endowment will be admitted by every one competent to form an opinion. Yet I would remark, at the outset, that the reasons sometimes advanced by students of science in support of this proposition are not of the worthiest, though they may be those best calculated to secure the alliance of the unscientific. Even Tyndall has spoken of science as though its chief value resided in its quality as "a source of individual and national might;" and many have dwelt on its value as a means of adding to material wealth. It would be affectation to contemn such considerations, but assuredly they do not present the noblest qualities of science, the chief good which science is competent to work. It is as a potent means of culture that science is worthiest of recognition. The material gain derived from scientific research has no doubt been great; but it has been incalculably surpassed in value by the change which science has worked and is working in the minds of men. It is, indeed, precisely in this respect that unscientific persons most completely misapprehend the work which science is doing. They attach special value to those things which science is silently but certainly displacing. They are pained by the light which science is pouring on objects that had seemed venerable so long as their defects had been veiled under the gloom of ignorance. They are appalled when science would teach them to displace all false loyalties by the noblest loyalty of all—loyalty to the truth. But the student of science can deal with such errors as he would deal with errors of observation or with untrustworthy experiments. He is not concerned to war against them. To be angry with them would be as unscientific as to be angry with gravitation. The true teachings of science will be recognized in due time—with results easily foretold. It was predicted that the religion of mercy would bring, not peace, but a sword; the seemingly stern religion of truth will bring, not a sword, but peace into the world. To recognize the universal reign of law is to perceive the futility of lawlessness, no matter under what high or even sacred names disguised. The culture of man through the study of truth is the work of science in the future. And scientific research derives incalculably greater value from the fact that it affords material for scientific culture than because it may add to national or individual power, or become a means of increasing our store of material wealth. Even the benefits

derived from those departments of science which tend most to ameliorate the condition of the masses, great though these benefits unquestionably are, must be esteemed small by comparison with those which will hereafter be derived from science as a means of mental and moral culture.

I am careful to deal with this point at the outset, because it removes any difficulty which might arise from the question of the relative value, commercial or otherwise, of various departments of science, or of different discoveries in any given department. Regarding science as a means of culture, all scientific discoveries are valuable, though not all equally so. Some which are least useful in the ordinary sense are preëminently valuable in this respect. To take an example from astronomy: Although it would be difficult to say that any scientific discovery cannot *possibly* confer material benefit on the human race, I suppose no discovery could promise less in this way than Sir W. Herschel's recognition of wide-spreading nebulosity in certain regions of the heavens. Follow out, however, the train of thought that this discovery suggests, and it will be found that the discovery has had an influence by no means insignificant in dispossessing ideas which have wrought in their day incalculable mischief. As Draper has well said, in his "Conflict between Religion and Science," the nebular hypothesis rests primarily on this discovery; and the recognition of the truth of that hypothesis compels us "to extend our views of the dominion of law, and to recognize its agency in the creation as well as in the conservation of the innumerable orbs that throng the universe." Is this recognition of the reign of law barren? Let the reader of the history of the last five hundred years consider only what would have been the influence, throughout that interval, of a clearly-defined and widely-spread belief in the dominion of law, and he will neither hesitate how to reply, nor question the value of such a belief in future ages. The doctrine of the universality of law, once understood by the masses, cannot but prove a safeguard against excesses such as have been and continue to be committed in the name of religion—a safeguard even against the very existence of the superstitions to which such excesses are due. The belief in universal law, regarded by many in these days as a rock ahead, will be one day recognized as a breakwater against seas which have been heavy and may be heavy yet again.

In this way of estimating the value of science, and therefore the importance of scientific research, we may find an answer to the difficulty which presents itself when we consider the actual position of scientific workers—the fact, namely, that the search for scientific truth affords the worker no direct means of maintenance. A

man may give many years of labor to discover some great law of Nature, or some important scientific fact, and when he has achieved success he may find that his discovery is his sole reward. This, indeed, may be the sole reward he has wrought for. Indeed, I think the true student of science would wish to dissociate from his special subject of research all idea of material reward. Yet it is as true of the minister and interpreter of Nature as of the minister and interpreter of religion, that "the laborer is worthy of his hire."

If the scientific worker is wealthy, and therefore presumably has abundant leisure, he will seek no material reward (precisely as those scions of wealthy families who enter the service of religion seek I suppose, no payment for their ministries). But it has been well remarked that "there is unfortunately no necessary connection between wisdom and the inheritance of riches; and consequently it is always within the bounds of possibility that a man of property may subsidize in his own person, not knowledge, but error, a mischievous crotchet or a perfectly fruitless and impossible inquiry, and may employ the contents of a bottomless purse in compelling the attention of the world to it.... There is also no guarantee in the case of a private person.... that the investigator is sufficiently furnished with the preliminary knowledge or training to make his remarks fruitful. In short, work supported by private means is very likely to be *amateur* work, or *duplicate* work.

Every man who desires to make researches in science, and who is not possessed of private means sufficient, not only for his support, but to provide for the expenses of his researches (in some cases necessarily heavy), must either select an occupation which will provide the required means without taking him from his special subject of research, or must simply withdraw from the scientific work he had proposed to undertake. The alternative may present itself to him at the outset of his career; or gradually as his scientific work becomes more and more difficult, through the pressure of other duties; or sudden losses may bring the alternative home to him, after original scientific work has already commenced. Of the third case I shall say little in what follows, as it is probably unusual, and, when it occurs, must, for the most part, lead to entire withdrawal from scientific work. In whatever way the alternative may present itself, the student of science who determines to continue his investigations is not troubled by any great difficulty in selecting the occupation which he will combine with the pursuit of knowledge. For the available occupations are few indeed.

There are some salaried posts to which light scientific duties (chiefly educational) are attached. But these are not commonly, I believe, to be obtained at the beginning of a scientific life, nor readily by those who find the gradual pressure of expenses interfering with scientific labors. They are not, indeed, necessarily awarded to science-workers at all; nor, when so held, have they invariably been found to encourage steady work in science. I am speaking, be it understood, of offices, professorial or otherwise, where the special duties are light, and where therefore it is to be understood that those appointed are expected to devote themselves to original scientific research. Where heavy duties are attached to offices of this kind, scientific research is necessarily checked. We have an example of this in some professorships in America, the holders of which are compelled to devote so much time to the routine of class-work, that they are barely able even to keep themselves abreast of the scientific work of the day. But in Great Britain there are several offices which would seem to have been specially designed to afford means and leisure for original scientific research. Yet, if we consider the total number of men holding such offices, their abilities, and their opportunities, we must admit that the results they achieve are not collectively so great as might be expected. In certain instances, indeed, it would almost seem as though election to these well-paid offices had been the sole end and aim of work seemingly undertaken from pure love of science, so thoroughly has original research ceased, or become unfruitful, when the desired post has been secured. We must not close our eyes to this fact, nor suffer the zeal and energy of the few to blind us to the negligence of many who hold such offices. The point is one which would have to be carefully considered in any scheme for the endowment of research. If physical research is ever to be freely endowed, some plan would have to be adopted to obtain honest and faithful workers—not men who would regard scientific discoveries only as a means of securing salaried idleness.

But most of the salaried offices at present open to science-workers have heavy, or at least wearisome, duties attached to them. A professor of science who has to attend daily in the class-room, to consider how to make clear to dull minds matters altogether familiar to him, to prepare or emend text-books, and to take also his share in the control of large bodies of young men, cannot possibly give any great portion of his energies to original research, "In a few cases," as Mr. Appleton remarks, in the paper from which I have already quoted, "a *little* research can be done; in the majority of probably the best instances, all that is possible to the teacher is to keep himself abreast of that which is being accomplished by others; in too many, it is to be feared that even this is rendered impracticable by the

exigencies of continual publicity," This publicity, indeed, must be of all others the most annoying hindrance to scientific research, I say *must* be, because my own course of life (except for occasional short intervals, at my own choice and under my own control) has been so completely that of the recluse, that I can only imagine the effects of a continued slavery to "the exigencies of publicity," Yet I have seen enough to feel assured that what Mr. Appleton describes as "the available store of nervous power" must be drawn upon far too largely, in most instances, to leave much energy for original research.

There remains, so far as the association of science and education is concerned, what may be called the literature of science. And here, I must confess, I do not share the opinion which has been expressed by some, that the purely scientific qualities must suffer in proportion as the expositional power is exercised. The habit of exposition developed by an educational calling may, indeed, as Mr. Appleton has remarked, "have a tendency to bring into prominence the element of form and phrase rather than that of substance," *if*, by an educational calling, we understand the routine of the class-room. Going continually over the same ground, the class-teacher must of necessity be unable to advance. But so far as the literature of science is concerned, even though the most elementary and popular forms of scientific literature be in question, this need not happen. The assertion that "the growth of the popular and rhetorical element—*die phrase in der Wissenschaft*—is almost always a symptom that the work of investigation is standing still," is not justified by facts. The most fruitful of our scientific workers are also those who have succeeded best in scientific literature. Sir J. Herschel, Lyell, Darwin, Huxley, Tyndall, Spencer, Grove, Lubbock, Tylor, Owen, Carpenter, Wallace: these are some among the men who have done most for the literature of science. They have not been checked in original research by the time devoted to such literature. Nay, I believe that every one of them would tell us that the hours so employed were among those most fruitful in suggestive thought, and therefore (by no means indirectly) in the advancement of original research. It appears to me—and here I speak to some degree from my own experience—that to write out a clear account of the results obtained during scientific work is so useful an exercise, that, apart from all question of the utility of popular treatises on science, the scientific worker should adopt the practice for his own sake. I feel sure that certain crude theories, which have been maintained by some who pride themselves most on avoiding the popular and rhetorical element, would have been abandoned had they been submitted to this process.

For my own part, however, I attach so much importance to the extension of sound scientific knowledge—so much more importance to this, I will even say, than to the results of the scientific researches of any man, or even of any body of men—that I regard as most earnestly to be deprecated all attempts to deprive our people of the literary services of those alone who can write effectively or satisfactorily about science—the scientific workers themselves. Too long what has been called the popularization of science has been attempted by unscientific persons. When men like Herschel and Lyell, Darwin, Tyndall, and Huxley, undertake the real popularization of science, we have at once the promise and the sign of progress. "But," Mr. Appleton says, "there is not wanting evidence that the popularization of science, in the best and most necessary meaning of the word, is in this country beginning largely to take the place of original study and investigation of truth." Where, however, is this evidence? Mr. Appleton must have been sorely pressed, when he can only find it in the fact that "in Oxford, where the business of education has been brought to a pitch of perfection almost unequaled elsewhere, the actual additions to knowledge that are made, in the course of a generation, in the old traditional studies of Latin and Greek philosophy, are, as compared with what is done in Germany, almost inappreciable." I am not concerned to deny this, or even to question it. It is the natural result of old traditional arrangements. But it proves nothing concerning the effect of the popularization of science in the best sense of the word—and as distinguished from what is often so called, but might more correctly be termed the vulgarization of science. It seems to me undeniable that the great improvement which has of late taken place in the work of correct scientific exposition has synchronized with a great increase in the amount of fruitful original research. I say simply that the two developments have synchronized; but I am strongly of opinion that they stand to each other in the relation of cause and effect. Not only does it appear to me that our Herschels, Darwins, Huxleys, Tyndalls, and so on, have gained as science workers rather than lost, by their work in popularizing science, but I cannot doubt that the number of science-workers, in the several departments to which their writings relate, has been largely increased by treatises which combine sound science with clear and elegant exposition.

There is another aspect in which the improved scientific literature of our time must be considered. It is unfortunate that modern scientific progress necessarily tends to increase the number of specialists. Not only is it impossible for any man to thoroughly master several departments of scientific research, but no man can be thoroughly master of a single science in all its developments. It is absolutely

necessary that there should be specialists—nay, every real worker in science must be a specialist. But while each science-worker has thus, and should have, his special branch of his own science, it is very desirable that he should also have a correct general view of other sciences. If he ought to know every thing about something, there is no reason why he should not know something about every thing.<sup>[4]</sup> It is just this something which the student of one science learns from a sound exposition of another science by a proficient therein. Every true popularizer of science knows that among his readers, if not even forming the greater number of his readers, there will be men of science, working in other branches, but still bringing to the study of his treatise their scientific training. Writing for them, he will write in the manner best suited to popularize without vulgarizing science: "the coarser developments of sensationalism" will be avoided, even if the good sense of the scientific worker were not normally opposed to all such faults of style. The literature of science owes much to the recognition of this circumstance.

Some may question, however, whether scientific literature can be sufficiently remunerative to support science-workers, even though they should turn altogether from original research, and devote their whole time to writing about science. I do not think, however, that much anxiety need be felt on this score. Of course, scientific literature is not at present, and perhaps may never be, so remunerative as novel-writing, historical literature, biography, travels, and so on. Very few writers on science, however general the interest attached to their researches, have earned an income of (let us say) five thousand pounds annually for many successive years; and I suppose the successful novelist would regard such an income as contemptible. Probably, in the majority of instances, it would be only by an almost entire withdrawal from original work, that the writer on science could earn a steady income of half that amount; while that earnestness in the cause of science which can alone render scientific writings attractive would compel the scientific author to devote a large share of his time to unremunerative work. Yet there can be no doubt that many of our most successful workers in science have been able, without forsaking original research, to gain very sufficient incomes by scientific literature, or by the associated work of popular scientific lecturing. The chief objection, perhaps, to this way of rendering scientific research self-supporting consists in the fact that every hour devoted to original work involves a pecuniary sacrifice, and the temptation must, in some instances, be strong to withdraw entirely, or for long intervals, from the real work of scientific research—even if this may not become, in many cases, an absolute duty.

Another source of remuneration for scientific workers depends on the value of scientific knowledge in certain departments of commercial enterprise. This means of support, however, though large in individual instances, is so limited in scientific range, that we need not stop to consider it in connection with the general question of support from workers in science. As Mr. Appleton justly remarks, "this source of maintenance is not only the exclusive privilege of physical science, but almost the exclusive privilege of one of the physical sciences. There is no commercial career open for a biologist, for instance; and the existence of a commercial career—and frequently a very lucrative one—for the chemist has the effect of starving all the other sciences for the benefit of one of them. One of our foremost teachers of biology complained to me not long ago that he was compelled to advise his best pupils, who were desirous of devoting themselves to a life of research, to give up their own study, and enter upon that of chemistry, as there was no prospect of a career for them in any thing else.

I have not spoken thus far of salaried offices which are apparently scientific but in reality involve continuous labor not tending greatly to the advancement of pure science. Such, for example, in astronomy, are the various offices, ruling as well as subordinate, in our great government observatories. The details of observatory-work are not, properly speaking, scientific. They involve, no doubt, the continuous application of scientific principles, but no such processes as are likely to lead to discoveries in science. The ordinary notion, for instance, that the large telescopes of our national observatories are employed in advancing our knowledge of astronomy, is altogether erroneous, as any one will perceive who examines the records of the work done in those observatories. All the original researches effected at Greenwich, since Flamsteed's time, would together form little more than a fair life's work for a single zealous student of astronomy, and would be incomparably surpassed in scientific interest by the work of either of the Herschels. The object for which government observatories are erected, in fact, precludes almost entirely the pursuit of original researches. The observations of the moon, for instance, which have formed so important a part of the work accomplished at Greenwich since Flamsteed's time, were not intended to add to our information about the physics of astronomy, though, of course, they have done so in a remarkable degree, studied as they have been by mathematicians (mostly outside Greenwich) from Newton downward. Their ostensible object was the improvement of navigation; and almost every observation made at Greenwich, until quite recently, was directed either to this end (the improvement of navigation as a

science) or to secure continued time-measurements, magnetic data, and other information for the guidance of seamen.—*Contemporary Review*.

## Part II

THE public endowment of science presents itself as a desirable supplement to the various means of maintenance considered in the previous part of this article. Those departments of science, in particular, which require costly instruments, which can only be pursued with the aid of trained assistants, or which, in other ways, involve greater expense than a man of ordinary means can afford, seem to require and deserve assistance from the national purse. On abstract principles, this use of the nation's wealth is strongly to be recommended. The subject is altogether worthy; the expenses would not be great, compared with others which are readily borne for purposes far less worthy; and this manner of supporting science commends itself to the respectful consideration of a nation accustomed, in spite of repeated disappointments, to regard state control as a surer resource than private efforts. I think every zealous student of science, to whom the subject might be submitted, would be apt, at a first view, to decide unhesitatingly that the endowment of science could not but be fruitful in good results.

So soon, however, as details are considered, and especially when candidates for the nation's money come forward and tell us precisely what they want, the matter assumes a different aspect.

So far as the source whence money could be provided for the endowment of science is concerned, there is little difficulty. The additional taxation required to meet all probable expenses would be so light as scarcely to be appreciable. But in truth a fund already exists out of which the cost of the endowment of science might be defrayed either wholly or in great part—the sums bequeathed in old times to the universities. Nor would this application of university property involve a departure from the purpose for which those sums were originally bequeathed. On the contrary, we have evidence to show that the universities were originally founded, not for educational purposes solely or chiefly, but for the advancement and preservation of knowledge. In the third report of the Commissioners for the Advancement of Science, we find that the witnesses examined were "on no point more united than in the expression of the feeling that it is a primary duty of the universities to assist in the advancement of learning and science, and not to be content with the position of merely educational bodies; and the evidence quoted shows that this opinion was based on the fact that such was the original purpose of

the universities—that, in fact, "the collegiate foundations of the universities were originally and fundamentally, although not absolutely and entirely, destined for" that object. "This object" proceeds the report, "is certainly not less important in modern than [it was] in ancient society. In the middle ages, knowledge would altogether have perished if it had not been for such foundations, and it appears that now, from other causes, the pursuit of knowledge and of general scientific investigation is subject to very real dangers, though of another kind than those which then prevailed, and which make it very desirable to preserve any institution through which scientific discovery and the investigation of truth may be promoted.

Granting, however, first the desirability of endowment for science on abstract principles, and secondly that the necessary funds either already exist, or can be easily raised, we find ourselves in presence of the practical difficulties involved in the distribution of such funds. Decision must be made: first, as to the scientific subjects which shall be selected for endowment; secondly, as to the persons under whose supervision the funds for this purpose should be distributed; and thirdly, as to the persons to whom these funds should be dispensed.

On the first point, it is to be noticed that, since, for a long time, the administration of endowment would chiefly rest with non-scientific persons, the question of the practical value of different scientific subjects would at first be of primary importance. It is not to be expected that the value which scientific researches possess, apart from all material benefits they may bring with them, should be generally recognized. A principle of selection would have to be adopted at first which men of science would regard as essentially unsound. Nevertheless, little direct mischief would follow from this circumstance, though many advantages would for a time be lost. The limitation would exclude subjects worthy of the highest consideration: but these are already excluded; and many subjects now receiving no public support would be admitted. I apprehend that the most unfortunate result of this state of things would flow from the fact that persons desirous of securing money grants for a scientific subject of the non-productive sort might be tempted, rather than allow the nation to neglect it, to *imaginematerial* advantages from its cultivation. I am not aware that many instances exist whereby to illustrate this point, or indeed that as yet any appeal has been made for special endowment save in a single instance. But this instance chances to illustrate my meaning exceedingly well.

It will probably be admitted that the practically useful applications of astronomy are at least as well provided for by the nation as those of any other branch of science, not excluding chemistry or pure physics. Occasionally, also, government has provided, not without generosity, for astronomical researches little likely to lead to results of practical utility. Recent eclipse expeditions, and still more the expeditions for observing the late transit, are instances in point, seeing that it is almost impossible to conceive that mankind can derive any direct benefits from a knowledge of the sun's surroundings, or of the distance, size, and mass of that luminary. But the nation makes no direct provision for researches into the physical condition and nature of the sun, the planets, stars, star-cloudlets, comets, the moon, and so on. Nor, probably, would an appeal for new observatories to meet this want receive general or effectual support at present. But, about three years ago, it was thought advisable, by two or three persons, to bring a scheme of this nature before the Astronomical Society, so as to secure the support of that body in submitting the matter to those in charge of the national purse. Of the fate of this scheme with the Astronomical Society I need say nothing, save that the Council were practically unanimous in rejecting it—only four voting in its favor. But I would direct particular attention to the nature of the argument used to obtain support for this scheme: "Permanent national provision," said its advocate, "is urgently needed for the cultivation of the physics of astronomy. If the study of the sun alone were in question, that alone would justify such a measure; for there can hardly be a doubt that almost every natural phenomenon connected with climate can be distinctly traced to the sun as the great dominating force, and the inference is unavoidable that the changes, and what we now call the uncertainties of climate, are connected with the constant fluctuations which we know to be perpetually occurring in the sun itself. The bearing of climatic changes on a vast array of problems connected with navigation, agriculture, and health, need but to be mentioned to show the importance of seeking, in the sun, where they doubtless reside, for the causes which govern these changes. It is, indeed, my conviction, that of all the fields now open for scientific cultivation, there is not one which, quite apart from its transcendent philosophical interest, promises results of such high utilitarian value as the exhaustive systematic study of the sun.

It would be fatal to scientific interests if such a mistake as this were often repeated. Yet we can have no assurance that the Government would not again and again be invited to support science on the strength of unfounded promises, if any wide scheme of endowment were adopted whose administration should be intrusted to non-scientific persons.

If the administration of the funds for scientific endowment were from the beginning intrusted to leading men of science, it is probable that correct scientific principles would be adopted for their guidance. But then a difficulty would arise which might prove even more serious than the mistakes of the unscientific. No one acquainted with the history or present condition of science, and with the relations which have existed and continue to exist among science-workers, can doubt that scientific managers of endowment funds would be repeatedly called upon to decide on the claims of methods or subjects to which they had conceived objections, and to vote respecting the candidature of scientific men against whom they entertained feelings of personal hostility. The first case can be illustrated by example, the other not so conveniently. Suppose Leverrier had been called upon to determine whether any sum from an endowment fund should be given prospectively for researches into the subject of transits of Venus, we may be sure (his actual course in the matter leaves no room for doubt) that his prepossession in favor of that method of measuring the solar system which is based upon the planetary perturbations would have led him to decide against any such grant. Many cases akin to this will occur to those familiar with recent controversies in various branches of scientific research. As to personal animosities, we may follow the convenient example of those writers who trace the faults of persons in high places down to a certain date, and leave the present time to the criticisms of future historians. It will be admitted that both Halley and Flamsteed were faithful servants of science; yet if either had had to decide on any question of awarding to the other some post of influence or emolument, it is to be feared, from what we know of their actual conduct toward each other, that the result would not have depended solely on scientific considerations. It may be hoped that there has been a change for the better since then, and that matters will improve still more hereafter. The advocates of rival theories, the leading teachers of different schools of thought, will one day, perhaps, be constantly on good terms with each other. Dissensions will be unknown in our scientific societies. The older men of science will be well pleased to see younger workers gradually modifying theories which had formerly seemed established forever, and the younger workers will never give unpleasant expression to the feeling that "authority" is not an absolutely certain guide in science. Jealousies and rivalries among those working in the same departments will gradually become things of the past. At present, all we can say is, that matters are improving at such a rate that... that they may be allowed, without disadvantage, to improve a little longer. If men of science were suddenly called upon to administer any extensive

scheme of public endowment for science, this improvement might be checked, which would be unfortunate.

As regards the class of men who would come forward if science were endowed, much would doubtless depend on the position offered to the candidates for office, and on the qualifications demanded. In these days of competitive examinations, it seems probable that careful preliminary inquiry would be made into the proficiency of the candidates, at least in departments of learning associated with their special science. Again, it may be presumed that every office under the new system would have definite duties attached to it, even though matters were so arranged that ample time would be left for original research. It ought certainly to be arranged, moreover, that from time to time every holder of a salaried office should be called upon to give satisfactory proof that he was not wasting his own time and the nation's money. It would be unpleasant if a large salary were assigned for life to a zealous student of science, and then, by some accident, his zeal diminished. The mere loss of so much money annually would be of little importance to the nation; but the discredit to science would be a very serious matter. Unfortunately, those who ought to know assert that among the persons who seem most earnest in the cause of science, and who not only seem, but *are* exceedingly earnest in advocating the endowment of science, there are not wanting men who may be characterized as "scientific Micawbers, waiting for something to turn up." They may be recognized by men of discernment, because of their tendency to dilate upon their own work, to take credit for the work or methods of others, and to urge (anticipating, perhaps, the endowment of science) that large salaries should be given for the discharge of exceedingly indefinite duties. In any wide scheme for the endowment of research these persons would have to be carefully watched. The money wasted on them would be a matter of very little moment; but science would be degraded in the eyes of the world, and mischief, not easily reparable, would be wrought, if such men as these worked their way into the best-paid offices.

It may, perhaps, be urged that a system of payment by results might be established. Mr. Mattieu Williams, the ingenious author of "The Fuel of the Sun," in a letter commenting upon a leading article (mine, as it chanced) in the *Chemical News* for September 5, 1873, advances this as the only sound and natural principle of public endowment for science. The case seems very simple as he presents it: "If a fund for the payment of scientific research existed," he says, "the genuine worker might send in his bill with the paper communicating the results of his researches, and

such a bill, after being fairly taxed, should be paid like any other honest account, in a simple and business-like manner. The toiler in the workshop of science who reveals a new truth is a benefactor to the whole of mankind, has a fair and honest claim against the whole human race, and is entitled to draw a bill accordingly, which should be accepted and honored by his own country at least. Decent gratitude and common honesty demand so much from the nation. It should be done, and may be done, without opening a door to jobbery or any multiplication of corrupt and idle pensioners." I fear that though this might, perhaps, be managed in Utopia or the New Atlantis, it could scarcely be effected in England or any other country at present existing. The accounts that would be handed in to the minister of science under any such system would present a strange medley of real and false discoveries. His time would be chiefly occupied in objecting to undue estimates of results, and in endeavoring (hopelessly) to settle rival claims of contending discoverers. Besides, it is absolutely impossible to devise any scale of valuation for scientific discoveries. Conceive the state of mind of the minister of science, who, after disposing of claims for the quadrature of the circle, the discovery of perpetual motion, new cosmogonies, schemes of weather prediction, and the like, should suddenly find himself called upon to decide the money value of some great achievement in science, such as Newton's discovery of universal gravitation, or Kirchhoff's interpretation of the solar spectrum.

Whether the intrinsic value of any result, or the time and labor it had cost, were considered, the difficulty of determining how much should be paid for it would be alike insuperable. If the former were the test, who should determine the intrinsic value? The discoverer might perhaps overrate it, or, if he were really an earnest student of science, he would either underrate it, or be unwilling to make any claim at all. Others would, for the most part, be unable to estimate the result at its true worth, if it were really a discovery of importance. For the discoverer must commonly be in advance of his fellow-workers in the department of research to which his discovery belongs. He alone knows the relation of his discovery to work already accomplished in the same direction. Let any specialist, who has just obtained some notable result, be asked to name half a dozen experts in his own subject to whose opinion he would be willing to submit his discovery, and it will be found that he will with difficulty name half as many, and those not specially eminent in that subject.

As to the amount of time and labor devoted to any subject of scientific research, it is tolerably certain that the nation would object to any system of retrospective

endowment based on that criterion. The ardent student of science gives many more hours of his time to his favorite subject of research than any government would be willing to pay for, at the present day, or for many years to come.

Past experience, not in scientific matters alone or chiefly, but generally wherever state maintenance has been provided for work which before had been carried on independently of the government, suggests that the wisest course would be to proceed tentatively. It is almost certain that any general scheme formed at the present time would hereafter have to be greatly modified, if not altogether abandoned. The time, indeed, has not yet arrived when the nation would look with satisfaction on any wide scheme of scientific endowment even if Parliament could be persuaded to make adequate grants for such a scheme, or to authorize the employment for that purpose of funds available at the two universities. As to the action of our legislators, it may be remarked that possibly a favorable vote might be secured, if the more earnest supporters of endowment (who have shown considerable strategic skill in pushing their schemes) should choose a convenient season and convenient hours for bringing the matter before Parliament. But it is to be hoped that science will not be degraded by a line of action implying that the endowment of science requires to be urged as cautiously in Parliament as an act relating to contagious diseases. The most liberal grant would be dearly purchased by the disgrace which such a proceeding would bring upon science.

The nation is probably willing to see experiments made on the effect of endowment for special scientific purposes. If such experiments were made, we should gradually perceive whether wider schemes were likely to be advantageous to science, or whether dangers may not lurk in all such schemes. It might be found that endowment would tend greatly to increase the number of those entering on scientific pursuits, while widening also the range of scientific culture. It might be found, as some assert, that endowment would give the younger men a better chance of making good progress than they at present possess. Or, on the other hand, it might be found that the national endowment of science would tend only to advance scientific Micawberism, and that the real workers in science would be discouraged by seeing all the best rewards given for pretentious novelties, clever adaptations perhaps of their own discoveries. That, too, which Herbert Spencer has described as "the rule of all services, civil, military, naval, or other," might be found to operate with the scientific service also—the rule, namely, of "putting young officials under old," with its necessary "effect of placing the advanced ideas and wider knowledge of a new generation under control of the ignorance and bigotry of

a generation to which change has become repugnant." This, "which is a seemingly ineradicable vice of public organizations, is a vice to which private organizations are far less liable; since, in the life-and-death struggle of competition, merit, even if young, takes the place of demerit, even if old.

It appears to me that those who really desire the advancement of science cannot too carefully or cautiously weigh the schemes now rife for the endowment of physical research. Unquestionably, the abstract proposition that science is worthy of national support must be admitted as just. We may agree with Sir John Herschel in feeling "prepared to advocate or defend" (on abstract principles) "a very large and liberal devotion indeed of the public means to setting on foot undertakings and maintaining establishments in which the investigation of physical laws and data should be the avowed and primary object, and practical application the secondary, incidental, and collateral one." It is hardly necessary for me to say that I recognize the full weight of those considerations which have been urged in favor of wide schemes of endowment. Such schemes have, indeed, had few warmer advocates than myself, nor has any one been more outspoken in their support. But practical experience has taught me, I must confess, that dangers—and serious ones—surround them. Even while as yet they were in their infancy, mischievous tendencies began to show themselves which had certainly not been anticipated by those earnest students of science who first supported the general principle that science deserves the recognition of the state. Greedy hands were stretched out for the promised prizes. Jobbery began its accustomed work; and those who sought to check its progress were abused and vilified. If this happened when schemes for endowment were but mentioned, what evil consequences might not be looked for if those schemes succeeded? Deterred by the consequences of the first few steps they had taken in the direction of endowment, many of the most zealous workers in science now stand aloof. Before long, however, the real position of affairs will be known. If the present desire for the endowment of research is prompted by genuine zeal for science, we shall find that the warmest advocates of the scheme are not those who would themselves profit by it. But if, on the other hand, it should appear that the persons who now speak most earnestly about the endowment of science are in reality eager chiefly for their own preferment, or desire to secure posts of emolument for personal friends and adherents, then every real lover of science must desire the failure of such schemes, seeing that the cause of science could not fail to suffer, nor Science herself to be degraded, should they prove successful.—*Contemporary Review.*