SCIENCE.—SUPPLEMENT.

FRIDAY, DECEMBER 10, 1886.

SCIENTIFIC MEN AND THEIR DUTIES.

THE honor of the presidency of such a society as this — carrying with it, as it does, the duty of giving at the close of the term of office an address on some subject of general interest — has been aptly compared to the little book mentioned in the Revelations of St. John, — the little book which was 'sweet in the mouth but bitter in the belly.' I can only thank you for the honor, and ask your indulgence as to the somewhat discursive remarks which I am about to inflict upon you.

There is a Spanish proverb to the effect that no man can at the same time ring the bell and walk in the procession. For a few moments to-night I am to ring the bell, and being thus out of the procession I can glance for a moment at that part of it which is nearest. At first sight it does not appear to be a very homogeneous or well-ordered parade, for the individual members seem to be scattering in every direction, and even sometimes to be pulling in opposite ways; yet there is, after all, a definite movement of the whole mass in the direction of what we call progress. It is not this general movement that I shall speak of, but rather of the tendencies of individuals or of certain classes; some of the molecular movements, so to speak, which are not only curious and interesting of themselves, but which have an important bearing upon the mass, and some comprehension of which is necessary to a right understanding of the present condition and future prospects of science in this country.

The part of the procession of which I speak is made up of that body or class of men who are known to the public generally as 'scientists,' 'scientific men,' or 'men of science.' As commonly used, all these terms have much the same significance; but there are, nevertheless, shades of distinction between them, and in fact we need several other terms for purposes of classification of the rather heterogeneous mass to which they are applied. The word 'scientist' is a coinage of the newspaper reporter, and, as ordinarily used, is very comprehensive. Webster defines a scientist as being 'one learned in science, a savant,' — that is, a wise man, — and the word is often used in this sense. But the suggestion which the word conveys to my mind is rather that of one whom the public suppose to be a wise man, whether he is so or not, of one who claims to be scientific. I shall therefore use the term 'scientist' in the broadest sense, as including scientific men, whether they claim to be such or not, and those who claim to be scientific men whether they are so or not.

By a scientific man I mean a man who uses scientific method in the work to which he specially devotes himself; who possesses scientific knowledge, not in all departments, but in certain special fields. By scientific knowledge we mean knowledge which is definite and which can be accurately expressed. It is true that this can rarely be done completely, so that each proposition shall precisely indicate its own conditions, but this is the ideal at which we aim. There is no man now living who can properly be termed a complete savant, or scientist, in Webster's sense of the word. There are a few men who are not only thoroughly scientific in their own special departments, but are also men possessed of much knowledge upon other subjects, and who habitually think scientifically upon most matters to which they give consideration; but these men are the first to admit the incompleteness and superficiality of the knowledge of many subjects which they possess, and to embrace the opportunity which such a society as this affords of meeting with students of other branches and of making that specially advantageous exchange in which each gives and receives, yet retains all that he had at first.

Almost all men suppose that they think scientifically upon all subjects; but, as a matter of fact, the number of persons who are so free from personal equation due to heredity, to early associations, to emotions of various kinds, or to temporary disorder of the digestive or nervous machinery, that their mental vision is at all times achromatic and not astigmatic, is very small indeed.

Every educated, healthy man possesses some scientific knowledge, and it is not possible to fix any single test or characteristic which will distinguish the scientific from the unscientific man. There are scientific tailors, bankers, and politicians, as well as physicists, chemists, and biologists. Kant's rule, that in each special branch of knowledge the amount of science, properly so called, is equal to the amount of mathematics it contains, corresponds to the definition of pure science as including mathematics and logic, and nothing

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else. It also corresponds to the distinction which most persons, consciously or unconsciously, make between the so-called physical, and the natural or biological sciences. Most of us, I presume, have for the higher mathematics, and for the astronomers and physicists who use them, that profound respect which pertains to comparative ignorance, and to a belief that capacity for the higher branches of abstract analysis is a much rarer mental quality than are those required for the average work of the naturalist. I do not, however, propose to discuss the hierarchy of the sciences; and the term 'science' is now so generally used in the sense of knowledge, more or less accurate, of any subject, more especially in the relations of causes and effects, that we must use the word in this sense, and leave to the future the task of devising terms which will distinguish the sciences, properly so called, from those branches of study and occupation of which the most that can be said is that they have a scientific side. It is a sad thing that words should thus become polarized and spoiled, but there seems to be no way of preventing it.

In a general way we may say that a scientific man exercises the intellectual more than the emotional faculties, and is governed by his reason rather than by his feelings. He should be a man of both general and special culture, who has a little accurate information on many subjects and much accurate information on some one or two subjects, and who, moreover, is aware of his own ignorance and is not ashamed to confess it.

We must admit that many persons who are known as scientists do not correspond to this definition. Have you never heard, and perhaps assented to, some such statements as these: "Smith is a scientist, but he doesn't seem to have good common sense," or "he is a scientific crank"?

The unscientific mind has been defined as one which "is willing to accept and make statements of which it has no clear conceptions to begin with, and of whose truth it is not assured. It is the state of mind where opinions are given and accepted without ever being subjected to rigid tests." Accepting this definition, and also the implied definition of a scientific mind as being the reverse of this, let us for a moment depart from the beaten track which presidential addresses usually follow, and, instead of proceeding at once to eulogize the scientific mind and to recapitulate the wonderful results it has produced, let us consider the unscientific mind a little, not in a spirit of lofty condescension and ill-disguised contempt, but sympathetically, and from the best side that we can find. As this is the kind of mind which most of us share with our neighbors, to a greater or less degree, it may be as well not to take too gloomy a view of it. In the first place, the men with unscientific minds form the immense majority of the human race.

Our associations, habits, customs, laws, occupations, and pleasures are, in the main, suited to these unscientific minds, whose enjoyment of social intercourse, of the every-day occurrences of life, of fiction, of art, poetry, and the drama, is perhaps none the less because they give and accept opinions without subjecting them to rigid tests. It is because there are a goodly number of men who do this that the sermons of clergymen, the advice of lawyers, and the prescriptions of physicians have a market value. This unscientific public has its uses. We can at least claim that we furnish the materials for the truly scientific mind to work with and upon; it is out of this undifferentiated mass that the scientific mind supposes itself to be developed by specialization, and from it that it obtains the means of its own existence. The man with the unscientific mind, who amuses himself with business enterprises, and who does not care in the least about ohms or pangenesis, may, nevertheless, be a man who does as much good in the world, is as valuable a citizen, and as pleasant a companion, as some of the men of scientific minds with whom we are acquainted.

And in this connection I venture to express my sympathy for two classes of men who have in all ages been generally condemned and scorned by others, namely, rich men and those who want to be rich.

I do not know that they need the sympathy, for our wealthy citizens appear to support with much equanimity the disapprobation with which they are visited by lecturers and writers, — a condemnation which seems in all ages to have been bestowed on those who have by those who have not.

So far as those who actually are rich are concerned, we may, I suppose, admit that a few of them — those who furnish the money to endow universities and professorships, to build laboratories, or to furnish in other ways the means of support to scientific men — are not wholly bad. Then, also, it is not always a man's own fault that he is rich; even a scientist may accidentally and against his will become rich.

As to those who are not rich, but who wish to be rich, whose chief desire and object is to make money, either to avoid the necessity for further labor, or to secure their wives and children from want, or for the sake of power and desire to rule, I presume it is unsafe to try to offer any apologies for their existence. But when it is claimed for

any class of men, scientists or others, that they do not want these things, it is well to remember the remarks made by old Sandy Mackay after he had heard a sermon on universal brotherhood: "And so the deevil's dead. Puir auld Nickie; and him so little appreciated, too. Every gowk laying his sins on auld Nick's back. But I'd no bury him until he began to smell a wee strong like. It's a grewsome thing is premature interment."

I have tried to indicate briefly the sense in which the terms 'scientist' and 'scientific man' are to be used and understood, and you see it is not an easy matter. The difficulty is less as regards the term 'man of science.' By this expression we mean a man who belongs to science peculiarly and especially, whose chief object in life is scientific investigation, whose thoughts and hopes and desires are mainly concentrated upon his search for new knowledge, whose thirst for fresh and accurate information is constant and insatiable. These are the men who have most advanced science, and whom we delight to honor, more especially in these later days, by glowing eulogiums of their zeal, energy, and disinterestedness.

The man of science, as defined by his eulogists, is the *beau idéal* of a philosopher, a man whose life is dedicated to the advancement of knowledge for its own sake, and not for the sake of money or fame, or of professional position or advancement. He undertakes scientific investigations exclusively or mainly because he loves the work itself, and not with any reference to the probable utility of the results. Such men delight in mental effort, or in the observation of natural phenomena, or in experimental work, or in historical research, in giving play to their imagination, in framing hypotheses and then in endeavoring to verify or disprove them, but always the main incentive is their own personal satisfaction (with which may be mingled some desire for personal fame), and not the pleasure or the good of others. Carried to an extreme, the eulogy of such men and their work is expressed in the toast of the Mathematical society of England: "Pure mathematics; may it never be of use to any man!" Now, it is one thing to seek one's own pleasure, and quite another thing to pride one's self upon doing so. The men who do their scientific work for the love of it do some of the best work, and, as a rule, do not pride themselves on it, or feel or express contempt for those who seek their pleasure and amusement in other directions. It is only from a certain class of eulogists of pure science, so called, that we get such specimens of scientific 'dudeism' as the toast just quoted, opposed to which may be cited the Arab saying that "a wise man without works is like a cloud without water."

There are other men who devote themselves to scientific work, but who prefer to seek information that may be useful; who try to advance our knowledge of nature's laws in order that man may know how to adapt himself and his surroundings to those laws, and thus be healthier and happier. They make investigations, like the men of pure science, — investigations in which they may or may not take pleasure, but which they make, even if tedious and disagreeable, for the sake of solving some problem of practical importance. These are the men who receive from the public the most honor, for it is seen that their work benefits others. After all, this is not peculiar to the votaries of science. In all countries and all times, and among all sorts and conditions of men, it has always been agreed that the best life, that which most deserves praise, is that which is devoted to the helping of others, which is unselfish, not stained by envy or jealousy, and which has as its main pleasure and spring of action the desire of making other lives more pleasant, of bringing light into the dark places, of helping humanity.

But, on the other hand, the man who makes a profession of doing this, and who makes a living by so doing, the professional philanthropist, whether he be scientist or emotionalist, is by no means to be judged by his own assertions. Some wise German long ago remarked that '*esel singen schlecht, weil sie zu hoch anstimmen*,' — that is, 'asses sing badly because they pitch their voices too high,' — and it is a criticism which it is well to bear in mind.

In one of the sermons of Kin O [1] the preacher tells the story of a powerful clam who laughed at the fears of other fish, saying that when he shut himself up he felt no anxiety; but on trying this method on one occasion when he again opened his shell he found himself in a fishmonger's shop. And to rely on one's own talents, on the services one may have rendered, on cleverness, judgment, strength, or official position, and to feel secure in these, is to court the fate of the clam.

There are not very many men of science, and there are no satisfactory means of increasing the number; it is just as useless to exhort men to love science, or to sneer at them because they do not, as it is to advise them to be six feet three inches high, or to condemn a man because his hair is not red.

While the ideal man of science must have a "clear, cold, keen intellect, as inevitable and as merciless in its conclusions as a logic engine," it would seem that, in the opinion of some, his greatness and superiority consist not so much in

[1] *Cornhill magazine*, August, 1869, p. 196.

the amount of knowledge he possesses, or in what he does with it, as in the intensity and purity of his desire for knowledge.

This so-called thirst for knowledge must be closely analogous to an instinctive desire for exercise of an organ or faculty, such as that which leads a rat to gnaw or a man of fine physique to delight in exercise. Such instincts should not be neglected. If the rat does not gnaw, his teeth will become inconvenient or injurious to himself, but it is not clear that he deserves any special eulogium merely because he gnaws.

It will be observed that the definition of a scientific man or man of science, says nothing about his manners or morals. We may infer that a man devoted to science would have neither time nor inclination for dissipation or vice; that he would be virtuous either because of being passionless or because of his clear foresight of the consequences of yielding to temptation.

My own experience, however, would indicate that either this inference is not correct or that some supposed scientific men have been wrongly classified as such. How far the possession of a scientific mind and of scientific knowledge compensates, or atones for, ill-breeding or immorality, for surliness, vanity, and petty jealousy, for neglect of wife or children, for uncleanliness, physical and mental, is a question which can only be answered in each individual case; but the mere fact that a man desires knowledge for its own sake appears to me to have little to do with such questions. I would prefer to know whether the man's knowledge and work are of any use to his fellowmen, whether he is the cause of some happiness in others which would not exist without him. And it may be noted that while utility is of small account in the eyes of some eulogists of the man of science, they almost invariably base their claims for his honor and support upon his usefulness.

The precise limit beyond which a scientist should not make money has not yet been precisely determined, but in this vicinity there are some reasons for thinking that the maximum limit is about $5,000 per annum. If there are any members of the Philosophical society of Washington who are making more than this, or who, as the result of careful and scientific introspection, discover in themselves the dawning of a desire to make more than this, they may console themselves with the reflection that the precise ethics and etiquette which should govern their action under such painful circumstances have not yet been formulated. The more they demonstrate their indifference to mere pecuniary considerations, the more creditable it is to them; so much all are agreed upon; but this is nothing new, nor is it specially applicable to scientists. Yet while each may and must settle such questions as regards himself for himself, let him be very cautious and chary about trying to settle them for other people. Denunciations of other men engaged in scientific pursuits on the ground that their motives are not the proper ones, are often based on insufficient or inaccurate knowledge, and seldom, I think, do good.

This is a country and an age of hurry, and there seems to be a desire to rush scientific work as well as other things. One might suppose, from some of the literature on the subject, that the great object is to make discoveries as fast as possible; to get all the mathematical problems worked out; all the chemical combinations made; all the insects and plants properly labelled; all the bones and muscles of every animal figured and described. From the point of view of the man of science there does not seem to be occasion for such haste. Suppose that every living thing were known, figured, and described. Would the naturalist be any happier? Those who wish to make use of the results of scientific investigation of course desire to hasten the work, and when they furnish the means we cannot object to their urgency; moreover, there is certainly no occasion to fear that our stock of that peculiar form of bliss known as ignorance will be soon materially diminished.

From my individual point of view, one of the prominent features in the scientific procession is that part of it which is connected with government work. Our society brings together a large number of scientific men connected with the various departments; some of them original investigators; most of them men whose chief, though not only, pleasure is study. A few of them have important administrative duties, and are brought into close relations with the heads of departments and with congress. Upon men in such positions a double demand is made, and they are subject to criticism from two very different stand-points. On the one hand are the scientists, calling for investigations which shall increase knowledge without special reference to utility, and sometimes asking that employment be given to a particular scientist on the ground that the work to which he wishes to devote himself is of no known use, and therefore will not support him. On the other hand is the demand from the business men's point of view, — that they shall show practical results; that in demands for appropriations from the public funds they shall demonstrate that the use to be made of such appropriations is for the public good, and that their accounts shall show that the money has been properly expended, — 'properly' not merely in the sense of usefully,

but also in the legal sense, — in the sense which was meant by congress in granting the funds. Nay, more, they must consider not only the intentions of congress, but the opinions of the accounting officers of the treasury, the comptroller and auditor, and their clerks, and not rely solely on their own interpretation of the statutes, if they would work to the best advantage, and not have life made a perpetual burden and vexation of spirit.

There is a tendency on the part of business men and lawyers to the belief that scientific men are not good organizers or administrators, and should be kept in leading-strings ; that it is unwise to trust them with the expenditure of, or the accounting for, money ; and that the precise direction in which they are to investigate should be pointed out to them ; in other words, that they should be made problem-solving machines as far as possible.

When we reflect on the number of persons who, like Mark Twain's cat, feel that they are 'nearly lightning on superintending,' on the desire for power and authority, which is almost universal, the tendency to this opinion is not to be wondered at. Moreover, as regards the man of science, there is some reason for it in the very terms by which he is defined, the characteristics for which he is chiefly eulogized.

The typical man of science is, in fact, in many cases an abnormity, just as a great poet, a great painter, or a great musician is apt to be, and this not only in an unusual development of one part of the brain, but in an inferior development in others. True, there are exceptions to this rule, — great and illustrious exceptions ; but I think we must admit that the man of science often lacks tact, and is indifferent to and careless about matters which do not concern his special work, and especially about matters of accounts and pecuniary details. If such a man is at the head of a bureau, whose work requires many subordinates and the disbursement of large sums of money, he may consider the business management of his office as a nuisance, and delegate as much of it as possible to some subordinate official, who, after a time, becomes the real head and director of the bureau. Evil results have, however, been very rare, and the recognition of the possibility of their occurrence is by no means an admission that they are a necessity, and still less of the proposition that administrative officers should not be scientific men.

I feel very sure that there are always available scientific men, thoroughly well informed in their several departments, who are also thoroughly good business men, and are as well qualified for administrative work as any. When such men are really wanted, they can always be found, and, as a matter of fact, a goodly number of them have been found, and are now in the government service.

The head of a bureau has great responsibilities ; and while his position is, in many respects, a desirable one, it would not be eagerly sought for by most scientific men if its duties were fully understood.

In the first place, the bureau chief must give up a great part of his time to routine hack work. During his business, or office, hours he can do little else than this routine work, partly because of its amount, and partly because of the frequent interruptions to which he is subjected. His visitors are of all kinds, and come from all sorts of motives, — some to pass away half an hour, some to get information, some seeking office. It will not work well if he takes the ground that his time is too important to be wasted on casual callers, and refers them to some assistant.

In the second place, he must, to a great extent at least, give up the pleasure of personal investigation of questions that specially interest him, and turn them over to others. It rarely happens that he can carry out his own plans in his own way, and perhaps it is well that this should be the case. The general character of his work is usually determined for him either by his predecessors, or by congress, or by the general consensus of opinion of scientific men interested in the particular subject or subjects to which it relates. This last has very properly much weight ; in fact, it has much more weight than one might suppose, if he judged from some criticisms made upon the work of some of our bureaus whose work is more or less scientific. In these criticisms it is urged that the work has not been properly planned and correlated ; that it should not be left within the power of one man to say what should be done ; that the plans for work should be prepared by disinterested scientific men, as, for instance, by a committee of the national academy ; and that the function of the bureau official should be executive only.

I have seen a good deal of this kind of literature within the last ten or twelve years, and some of the authors of it are very distinguished men in scientific work ; yet I venture to question the wisdom of such suggestions. As a rule, the plans for any extended scientific work to be undertaken by a government department are the result of very extended consultations with specialists, and meet with the approval of a majority of them. Were it otherwise, the difficulties in obtaining regular annual appropriations for such work would be great and cumulative, for in a

short time the disapproval of the majority of the scientific public would make itself felt in congress. It is true that the *vis inertiae* of an established bureau is very great. The heads of departments change with each new administration, but the heads of bureaus remain; and if an unfit man succeeds in obtaining one of these positions, it is a matter of great difficulty to displace him; but it seems to me to be wiser to direct the main effort to getting right men in right places rather than to attempt to elaborate a system which shall give good results with inferior men as the executive agents, which attempt is a waste of energy.

You are all familiar with the results of the inquiry which has been made by a congressional committee into the organization and work of certain bureaus which are especially connected with scientific interests, and with the different opinions which this inquiry has brought out from scientific men. I think that the conclusion of the majority of the committee -- that the work is, on the whole, being well done, and that the people are getting the worth of their money — is generally assented to. True, some mistakes have been made, some force has been wasted, some officials have not given satisfaction; but is it probable that any other system would give so much better results that it is wise to run the risks of change?

This question brings us to the only definite proposition which has been made in this direction, namely, the proposed department of science, to which all the bureaus whose work is mainly scientific, such as the coast survey, the geological survey, the signal service, the naval observatory, etc., shall be transferred.

The arguments in favor of this are familiar to you, and, as regards one or two of the bureaus, it is probable that the proposed change would effect an improvement; but as to the desirability of centralization and consolidation of scientific interests and scientific work into one department under a single head, I confess that I have serious doubts.

One of the strongest arguments in favor of such consolidation that I have seen is the address of the late president of the Chemical society of Washington, Professor Clarke, 'On the relations of the government to chemistry,' delivered about a year ago. Professor Clarke advises the creation of a large, completely equipped laboratory, planned by chemists and managed by chemists, in which all the chemical researches required by any department of the government shall be made, and the abandonment of individual laboratories in the several bureaus on the ground that these last are small, imperfectly equipped, and not properly specialized; that each chemist in them has too broad a range of duty and receives too small a salary to command the best professional ability. He would have a national laboratory, in which one specialist shall deal only with metals, another with food-products, a third with drugs, etc., while over the whole, directing and correlating their work, shall preside the ideal chemist, the all-round man, recognized as the leader of the chemists of the United States. And so should the country get better and cheaper results. It is an enticing plan, and one which might be extended to many other fields of work. Granting the premises that we shall have the best possible equipment, with the best possible man at the head of it, and a sufficient corps of trained specialists, each of whom will contentedly do his own work as directed and be satisfied, so that there shall be no jealousies, or strikes, or boycotting, and we have made a long stride toward Utopia. But before we centralize in this way we must settle the question of classification. Just as in arranging a large library there are many books which belong in several different sections, so it is in applied science. Is it certain that the examination of food-products or of drugs should be made under the direction of the national chemist rather than under that of the departments which are most interested in the composition and quality of these articles? This does not seem to me to be a self-evident proposition by any means. The opinion of a scientific man as to whether the government should or should not undertake to carry out any particular branch of scientific research and publish the results, whether it should attempt to do such work through officers of the army and navy, or more or less exclusively through persons specially employed for the purpose, whether the scientific work shall be done under the direction of those who wish to use, and care only for, the practical results, or whether the scientific man shall himself be the administrative head and direct the manner in which his results shall be applied, — the opinion of a scientific man on such points, I say, will differ according to the part he expects or desires to take in the work, according to the nature of the work, according to whether he is an army or navy officer or not, according to whether he takes more pleasure in scientific investigations than in administrative problems, and so forth.

It is necessary, therefore, to apply a correction for personal equation to each individual set of opinions before its true weight and value can be estimated, and, unfortunately, no general formula for this purpose has yet been worked out.

I can only indicate my own opinions, which are

those of an army officer, who has all he wants to do, who does not covet any of his neighbors' work or goods, and who does not care to have any more masters than those whom he is at present trying to serve. You see that I give you some of the data for the formula by which you are to correct my statements, but this is all I can do.

I am not inclined at present to urge the creation of a department of science as an independent department of the government having at its head a cabinet officer. Whether such an organization may become expedient in the future seems to me doubtful; but at all events I think the time has not yet come for it.

I do not believe that government should undertake scientific work merely or mainly because it is scientific, or because some useful results may possibly be obtained from it. It should do, or cause to be done, such scientific work as is needful for its own information and guidance when such work cannot be done, or cannot be done so cheaply or conveniently by private enterprise. Some kinds of work it can best have done by private contract, and not by officials; others, by its own officers. To this last class belong those branches of scientific investigation, or the means for promoting them, which require long-continued labor and expenditure on a uniform plan; such as the work of the government observatory, of the government surveys, of the collection of the statistics which are so much needed for legislative guidance, and in which we are at present so deficient, the formation of museums and libraries, and so forth.

Considering the plans and operations of these government institutions from the point of view of the scientific public, it is highly desirable that they should contribute to the advancement of abstract science, as well as to the special practical ends for which they have been instituted; but from the point of view of the legislator, who has the responsibility of granting the funds for their support, the practical results should receive the chief consideration, and therefore they should be the chief consideration on the part of those who are to administer these trusts. It must be borne in mind that while the average legislator is, in many cases, not qualified to judge *a priori* as to what practical results may be expected from a given plan for scientific work, he is, nevertheless, the court which is to decide the question according to the best evidence which he can get, or, rather, which is brought before him, and it is no unimportant part of the duty of those who are experts in these matters to furnish such evidence.

But in saying that practical results should be the chief consideration of the government and of its legislative and administrative agents it is not meant that these should be the only considerations. In the carrying out of any extensive piece of work which involves the collection of data, experimental inquiry, or the application of scientific results under new conditions, there is more or less opportunity to increase knowledge at the same time and with comparatively little increased cost. Such opportunity should be taken advantage of, and is also a proper subsidiary reason for adopting one plan of work in preference to another, or for selecting for appointment persons qualified not only to do the particular work which is the main object, but also for other allied work of a more purely scientific character.

On the same principle it seems to me proper and expedient that when permanent government employees have at times not enough to do in their own departments, and can be usefully employed in scientific work, it is quite legitimate and proper to thus make use of them. For example, it is desirable that this country should have such an organization of its army and navy as will permit of rapid expansion when the necessity arises, and this requires that more officers shall be educated and kept in the service than are needed for military and naval duty in time of peace. It has been the policy of the government to employ some of these officers in work connected with other departments, and especially in work which requires such special training, scientific or administrative, or both, as such officers possess. To this objections are raised, which may be summed up as follows: —

First, that such officers ought not to be given positions which would otherwise be filled by civilian scientists, because these places are more needed by the civilians as a means of earning subsistence, and because it tends to increase the competition for places and to lower salaries. But in other words, the argument is that it is injurious to the interests of scientific men, taken as a body, that the government should employ in investigations or work requiring special knowledge and skill men who have been educated and trained at its expense, and who are permanently employed and paid by it. This is analogous to the trades union and the anti-convict labor platforms.

The second objection is that army and navy officers do not, as a rule, possess the scientific and technical knowledge to properly perform duties lying outside of the sphere of the work for which they have been educated, and that they employ as subordinates really skilled scientific men, who make the plans and do most of the work, but do not receive proper credit for it. The reply to this is that it is a question of fact in each particular case, and that if the officer is able to select and

employ good men to prepare the plans and to do the work, this in itself is a very good reason for giving him the duty of such selection and employment.

A third objection is that when an officer of the army or navy is detailed for scientific or other special work, the interests of this work and of the public are too often made subordinate to the interests of the naval or military service, more especially in the matter of change of station. For example, civil engineers object to the policy of placing river and harbor improvements in the hands of army engineers, because one of the objects kept in view by the war department in making details for this purpose is to vary the duty of the individual officer from time to time so as to give him a wider experience. Hence it may happen that an officer placed on duty in connection with the improvement of certain harbors on the Great Lakes shall, after three or four years, and just as he has gained sufficient experience of the peculiarities of lake work to make his supervision there peculiarly valuable, be transferred to work on the improvement of the Lower Mississippi, with which he may be quite unfamiliar.

In like manner Professor Clarke objects to having a laboratory connected with the medical department of the navy on the ground that the officer in charge is changed every three years; consequently science suffers in order that naval routine may be preserved.

There is force in this class of objections, but the moral I should draw from them is, not that army and navy officers should not be allowed to do work outside their own departments or in science, but that when they are put upon such duty, the ordinary routine of change of station every three or four years should not be enforced upon them without careful consideration of the circumstances of the case, and satisfactory evidence that the work on which they are engaged will not suffer by the change. And, as a matter of fact, I believe this has been the policy pursued, and instances could be given where an officer has been kept twenty years at one station for this very reason.

I pass over a number of objections that I have heard made to the employment of army and navy officers as administrators, on the ground that they are too 'bumptious,' or 'domineering,' or 'supercilious,' or 'finicky,' because every one knows what these mean and their force. An army officer is not necessarily a polished gentleman; neither is a civilian; and a good organizer and administrator, whether officer or civilian, will at times, and especially to some people, appear arbitrary and dictatorial.

There is another objection to special details of army or navy officers for scientific duties which comes not so much from outside persons as from the war department and the officers themselves, and it is this: among such officers there are always a certain number who not only prefer special details to routine duty, but who actively seek for such details, who are perpetual candidates for them.

The proportion of men whose ideas as to their own scientific acquirements, merits, and claims to attention, are excessive as compared with the ideas of their acquaintances on the same points, is not greater in the army than elsewhere; but when an army officer is afflicted in this way, the attack is sometimes very severe, and the so-called influence which he brings to bear may cause a good deal of annoyance to the department, even if it be not sufficient to obtain his ends. I have heard officers of high rank, in a fit of impatience under such circumstances, express a most hearty and emphatic wish that no special details were possible, so that lobbying for them should be useless. This, however, seems to me to be too heroic a remedy for the disease, which, after all, only produces comparatively trifling irritation and discomfort.

The same evil exists, to a much greater extent, in the civil branches of the government. Few persons can fully appreciate the loss of time, the worry, and the annoyance to which the responsible heads of some of our bureaus for scientific work are subjected through the desire of people for official position and for maintenance by the government. They have to stand always at the bat and protect their wickets from the balls which are bowled at them in every direction, even from behind by some of their own subordinates.

It is true that a great majority of the balls go wide and cause little trouble, and a majority of the bowlers soon get tired and leave the field; but there are generally a few persistent ones who gradually acquire no small degree of skill in discovering the weak or unguarded points, and succeed in making things lively for a time. Considered from the point of view of the public interests, such men are useful, for although they cause some loss of valuable time, and occasionally do a little damage by promoting hostile legislation, yet their criticisms are often worth taking into account; they tend to prevent the machine from getting into a rut, and they promote activity and attention to business on the part of administrative chiefs. It is a saying among dog-fanciers that a few fleas on a dog are good for him rather than otherwise, as they compel him to take some exercise under any circumstances.

At all events, I think it very doubtful whether the jealousies and desire for position for one's self or one's friends which exist under present circumstances would be materially diminished under any other form of organization, even under a department of science.

Some conflict of interests now exists, it is true; some work is duplicated; but neither the conflict nor the duplication are necessarily wholly evil in themselves, nor in so far as they are evil are they necessary parts of the present system. This system is of the nature of a growth; it is organic, and not a mere pudding-stone aggregation of heterogeneous materials, and the wise course is to correct improper bendings and twistings gradually, prune judiciously, and go slow in trying to secure radical changes lest death or permanent deformity result.

It will be seen that in what I have said I have not attempted to eulogize science or scientists in the abstract. I should be very sorry, however, to have given any one the impression that I think they should not be eulogized. Having read a number of eloquent tributes to their importance by way of inducing a proper frame of mind in which to prepare this address, it is possible that I overdid it a little, and was in a sort of reaction stage when I began to write. But the more I have thought on the subject, and the more carefully I have sought to analyze the motives and character of those of my acquaintances who are either engaged in scientific work or who wish to be considered as so doing, and to compare them with those who have no pretensions to science, and who make none, the more I have been convinced that upon the whole the eulogium is the proper thing to give, and that it is not wise to be critical as to the true inwardness of all that we see or hear.

At least nine-tenths of the praises which have been heaped upon scientific men as a body are thoroughly well deserved. Among them are to be found a very large proportion of true gentlemen, larger, I think, than is to be found in any other class of men, — men characterized by modesty, unselfishness, scrupulous honesty, and truthfulness, and by the full performance of their family and social duties.

Even their foibles may be likable. A little vanity or thirst for publicity, zeal in claiming priority of discovery, or undue wrath over the other scientist's theory, does not and should not detract from the esteem in which we hold them. A very good way of viewing characteristics which we do not like is to bear in mind that different parts of the brain have different functions; that all of them cannot act at once, and that their tendencies are sometimes contradictory.

There are times when a scientific man does not think scientifically, when he does not want to so think, and possibly when it is best that he should not so think. There is wisdom in Sam. Lawson's remark that "folks that are always telling you what they don't believe are sort o' stringy and dry. There ain't no 'sorption got out o' not believing nothing." At one time the emotional, at another the intellectual, side of the scientific man has the ascendency, and one must appeal from one state to the other. Were scientific thinking rigorously carried out to practical results in everyday life, there would be some very remarkable social changes, and perhaps some very disagreeable ones.

That scientific pursuits give great pleasure without reference to their utility, or to the fame or profit to be derived from them, that they tend to make a man good company to himself and to bring him into pleasant associations, is certain; and that a man's own pleasure and happiness are things to be sought for in his work and companionship is also certain. If in this address I have ventured to hint that this may not be the only, nor even the most important, object in life, — that one may be a scientific man, or even a man of science, and yet not be worthy of special reverence because he may be at the same time an intensely selfish man, and even a vicious man, — I hope that it is clearly understood that it is with no intention of depreciating the glory of science, or the honor which is due to the large number of scientific gentlemen whom I see around me. A scientific gentleman! All praise to him who merits this title: it is the blue ribbon of our day.

We live in a fortunate time and place, — in the early manhood of a mighty nation, and in its capital city, which every year makes more beautiful, and richer in the treasures of science, literature, and art, which all the keels of the sea and the iron roads of the land are bringing to it. Life implies death; growth presages decay; but we have good reasons for hoping that for our country and our people the evil days are yet far off. Yet we may not rest and eat lotus; we may not devote our lives to our own pleasure, even though it be pleasure derived from scientific investigation. No man lives for himself alone; the scientific man should do so, least of all. There never was a time when the world had more need of him, and there never was a time when more care was needful lest his torch should prove a firebrand and destroy more than it illuminates.

The old creeds are quivering; shifting; changing like the colored flames on the surface of the Bessemer crucible. They are being analyzed, and accounted for, and toned down, and explained,

until many are doubting whether there is any solid substratum beneath : but the instinct which gave those creeds their influence is unchanged.

The religions and philosophies of the orient seem to have little in common with modern science. The sage of the east did not try to climb the ladder of knowledge step by step. He sought a wisdom which he supposed far superior to all knowledge of earthly phenomena obtainable through the senses. The man of science of the west seeks knowledge by gradual accumulation, striving by comparison and experiment to eliminate the errors of individual observations, and doubting the possibility of attaining wisdom in any other way. The knowledge which he has, or seeks, is knowledge which may be acquired partly by individual effort and partly by co-operation, which requires material resources for its development, the search for which may be organized and pursued through the help of others, which is analogous in some respects to property which may be used for power or pleasure. The theologian and the poet claim that there is a wisdom which is not acquired, but attained to, which cannot be communicated or received at pleasure, which comes in a way vaguely expressed by the words 'intuition,' or 'inspiration,' which acts through and upon the emotional rather than the intellectual faculties, and which, thus acting, is sometimes of irresistible power in exciting and directing the actions of individuals and of communities.

The answer of the modern biologist to the old Hebrew question, viz., "Why are children born with their hands clinched, while men die with their hands wide open?" would not in the least resemble that given by the rabbis ; yet this last it is well that the scientist should also remember : "Because on entering the world men would grasp every thing, but on leaving it all slips away." There exist in men certain mental phenomena, the study of which is included in what is known as ethics, and which are usually assumed to depend upon what is called moral law. Whether there is such a law, and whether, if it exists, it can be logically deduced from observed facts in nature or is only known as a special revelation, are questions upon which scientific men in their present stage of development are not agreed. There is not yet any satisfactory scientific basis for what is recognized as sound ethics and morality throughout the civilized world : these rest upon another foundation.

This procession, bearing its lights of all kinds, smoky torches, clear-burning lamps, farthing rushlights, and sputtering brimstone matches, passes through the few centuries of which we have a record, illuminating an area which varies, but which has been growing steadily larger. The individual members of the procession come from, and pass into, shadow and darkness, but the light of the stream remains. Yet it does not seem so much darkness, an infinite night, whence we come and whither we go, as a fog which at a little distance obscures or hides all things, but which, nevertheless, gives the impression that there is light beyond and above it. In this fog we are living and groping, stumbling down blind alleys, only to find that there is no thoroughfare, getting lost and circling about on our own tracks as on a *jumbie* prairie ; but slowly and irregularly we do seem to be getting on, and to be establishing some points in the survey of the continent of our own ignorance.

In some directions the man of science claims to lead the way ; in others, the artist, the poet, the devotee. Far-reaching as the speculations of the man of science may be, ranging from the constitution and nature of a universal protyle, through the building of a universe to its resolution again into primal matter or modes of motion, he can frame no hypothesis which shall explain consciousness, nor has he any data for a formula which shall tell what becomes of the individual when he disappears in the all-surrounding mist. Does he go on seeking and learning in other ways or other worlds? The great mass of mankind think that they have some information bearing on these questions ; but, if so, it is a part of the wisdom of the orient, and not of the physical or natural science of the occident. Whether after death there shall come increase of knowledge, with increase of desires and of means of satisfying them, or whether there shall be freedom from all desire, and an end of coming and going, we do not know ; nor is there any reason to suppose that it is a part of the plan of the universe that we should know. We do know that the great majority of men think that there are such things as right and duty, — God and a future life, — and that to each man there comes the opportunity of doing something which he and others recognize to be his duty. The scientific explanation of a part of the process by which this has been brought about, as by natural selection, heredity, education, progressive changes in this or that particular mass of brain matter, has not much bearing on the practical question of 'What to do about it?' But it does, nevertheless, indicate that it is not a characteristic to be denounced, or opposed, or neglected, since, even in the 'struggle-for-existence' theory, it has been, and still is, of immense importance in human social development.

"Four men," says the Talmud, "entered Para-

dise. One beheld and died. One beheld and lost his senses. One destroyed the young plants. One only entered in peace and came out in peace." Many are the mystic and cabalistic interpretations which have been given of this saying; and if for 'Paradise' we read the 'world of knowledge,' each of you can no doubt best interpret the parable for himself. Speaking to a body of scientific men, each of whom has, I hope, also certain unscientific beliefs, desires, hopes, and longings, I will only say, 'Be strong and of a good courage.' As scientific men, let us try to increase and diffuse knowledge; as men and citizens, let us try to be useful; and, in each capacity, let us do the work that comes to us honestly and thoroughly, and fear not the unknown future.

When we examine that wonderful series of wave-marks which we call the spectrum, we find, as we go downwards, that the vibrations become slower, the dark bands wider, until at last we reach a point where there seems to be no more movement; the blackness is continuous, the ray seems dead. Yet within this year Langley has found that a very long way lower down the pulsations again appear, and form, as it were, another spectrum; they never really ceased, but only changed in rhythm, requiring new apparatus or new senses to appreciate them. And it may well be that our human life is only the lower spectrum, and that beyond and above the broad black band which we call death there are other modes of impulses, — another spectrum which registers the ceaseless beats of waves from the great central fountain of force, the heart of the universe, in modes of existence of which we can but dimly dream.

CLARK'S PHILOSOPHY OF WEALTH.

'A REMARKABLE book!' Such is my involuntary exclamation as I finish reading Professor Clark's book, 'The philosophy of wealth.' In reviewing it I suffer in several ways under an 'embarrassment of riches.' There are so many excellent features of the work that it is difficult to select one or two for treatment, and there are so many passages in my copy marked for quotation that they would occupy far more space than can be given to the entire review. It seems, under the circumstances, best to abandon any idea of an exhaustive treatment of this admirable book, and simply attempt to notice a few of its characteristics in the hope that many may be induced to confer a benefit on themselves by its perusal.

The philosophy of wealth. By J. B. CLARK. Boston, *Ginn*, 1886. 12°.

'The philosophy of wealth' is a treatment of fundamental principles in economics, in which every page is luminous with clear analysis and profound thought. Yet the entire work is most practical, and should attract the attention of all interested in the problems of the day; for nothing is more needed at the present time than deeper knowledge. People lose themselves in a maze of stock-phrases, and continue to move in the same weary circle because they fail to grasp primary principles.

Professor Clark very properly lays emphasis on this point in his first chapter. He says, "If obscurity still hangs over principles, the clear apprehension of which is essential to all reasoning on the subject, the removal of it, besides having an incalculable value in itself, will afford a welcome supplement to directly practical work. It will shed light on the pressing social questions of the day. In the present state of the public mind, for example, financial heresies and strange teachings concerning the rights of property find a ready circulation; and if these false doctrines connect themselves, even remotely, with fundamental errors of political economy, then the assault upon the practical fallacies can never be quite successful until the underlying errors be exposed and corrected. Questions on the solution of which the general prosperity depends cannot be solved without the clear apprehension of correct principles."

The scope of the work may most readily be gathered from the titles of the chapters, which are the following: Wealth; Labor and its relation to wealth; The basis of economic law; The elements of social service; The theory of value; The law of demand and supply; The law of distribution; Wages as affected by combinations; The ethics of trade; The principles of co-operation; Non-competitive economics; The economic function of the church.

One of the best examples of clear analysis of economic phenomena is found in the discussion of utilities. There is first a distinction between absolute and effective utility, which explains satisfactorily the apparent contradiction, found in old treatises, between high value in use and low value in exchange. Water is said to be useful, for example, but to have no value. The logical ambiguity lies in this: when we say water is more useful than diamonds, we think of water in the abstract; when we say water has no value, we think of a definite concrete amount of water, a glassful for example. But that has also very little use. If my glass is upset, I do not grieve: I have no special attachment to that particular concrete water, and I get some more without difficulty.