the Custom House, Mining Bureau, Forestry Bureau, Agricultural Department and Board of Health; diagnostic work for the hospitals and others interested, and researches in gutta-percha, rubber and gums found in the islands, as well as investigations of some previously unknown forms of tropical diseases. The scope of the work is continually widening, and there is no doubt but that the bureau offers large opportunities for young men who desire to acquaint themselves with the products of the tropics and to advance our knowledge of lines of work which are each year concentrating more and more of the interest of the scientific world.

The positions in the bureau, outside of the directors, are all under the Civil Service, and qualifications can be obtained through the Civil Service Commission at Washington. The scheme of the bureau contemplates the following additions to the laboratory force during the next year:

1 Soil and water analyst	$1,500
1 Plant pathologist	2,500
1 Physical chemist	2,400
1 Analytical chemist for mineral analysis	2,000
1 Assayer	1,500
1 Entomologist	2,500
1 Animal parasitologist	2,500
1 Pathologist	2,400
1 Drug assayer and toxicologist	1,800

The candidates for the higher salaried positions by understanding will not be subjected to a rigid examination, but their previous research work, experience, university degrees and general knowledge will qualify them, after the facts have been submitted to the Civil Service Board and found satisfactory.

The salaries for young men are good, and, although expenses in Manila are higher than in the United States, nevertheless, the difference in salaries is large enough so that prospective workers will be better paid here than they would in the beginning positions in the United States. It is the intention to engage none but the most efficient workers in the corps, and it is hoped, in the course of a few years, a connection with the Bureau of Government Laboratories will be equivalent to a certificate of the superior attainments.

The plan of the institution contemplates the reservation of a certain number of research rooms in the laboratory building. These are to be at the disposition of independent investigators who wish to come to the islands for a temporary period as the guests of the laboratories. These workers will be furnished all the laboratory facilities they desire, and it is hoped that the opportunities offered will render scientific study in the tropics easy of access to all who have planned to undertake certain lines of work in which they are interested.

Paul C. Freer,
Superintendent of Government Laboratories.

THE CARNEGIE INSTITUTION.

Aid to research may be given either to individuals or to groups or organizations of individuals.

One of the chief obstacles in this country at present to research by individuals is the lack of time for continuous, well-adjusted work. The majority of the persons engaged in active scientific investigation in the United States are connected with colleges or universities, and in nearly every instance definite accomplishment is expected from them in the way of instruction and administration. The exigencies—real or fancied—of university administration often lead to wasteful repetition of courses and to the exhaustion of energy in barren details of executive routine and elementary instruction. The most common complaint heard from American men of science is not regarding inadequate salaries, but regarding the scanty time afforded them for the work of investigation. While in some cases this

attitude may be temperamental and not to be remedied by the acquisition of greater leisure, in a great many instances it represents the real barrier to be removed. More ample time for research can be afforded highly qualified individual workers by provision for research assistants, provision for the purchase or manufacture of special or expensive apparatus, or possibly by arrangement with university authorities for relief from an undue burden of elementary instruction.

In addition to the assistance that may be afforded individual workers of maturity and position, there is a scarcely less important field open in the granting of assistance to those just entering upon a professional career. It is no longer true that the attainment of the degree of doctor of philosophy carries with it the immediate offer of a college chair or indeed of any position whatever. The period intervening between the obtaining of the doctorate and the securing of a satisfactory academic position is often the most critical in the whole career of the young investigator. American conditions have not favored the engrafting of the docent system, and as matters stand at present there is nothing to bridge over this difficult transition period. Men with promise of high capability for investigation are often forced at this stage into the premature preparation of text-books or into other still less permanently valuable activities. It is of course not true that all young men receiving the degree of doctor of philosophy are equally worthy of assistance, but there are always some among each year's graduates who should not be smothered with routine or with bread-and-butter work before they have been allowed to develop their powers to the fullest extent. The whole future of research depends upon these beginning investigators, and the best of them should be carefully sought for, and when found given every opportunity to make the most of themselves.

Organized groups or associations of scientific men may further the interests of research in a somewhat different way. Undertakings impossible for the individual workers may be set on foot and carried through to a triumphant conclusion by the cooperation of many workers in different localities; extended series of experiments may be carefully planned and coordinated, and a system for the rapid interchange of results and methods may be made to accelerate greatly the work in hand without in any way curtailing the independence or freedom of the individual worker. There are already instances—as in the study of the physiological action of alcohol—where such cooperative, coordinated methods have been effectively applied. This tendency is apparent in many directions. Special institutes for the study of cancer and of scarlet fever, special committees for the study of biological variation, of atomic weight, of water analysis and of many other topics appealing to considerable groups of workers are utilizing the services of many individuals and are greatly facilitating concentration along effective lines. The impulse towards economy of energy that has led to industrial concentration is forcing upon scientific work the same necessity. Isolated, desultory work is becoming distinctly less effective; researches by groups of investigators, whether of master and pupils or of larger groups, are playing an increasing part in the advancement of science. Some branches of scientific work are especially fortunate in possessing already well-organized associations for the advancement of research. The eminent group of naturalists who have founded and maintained the Marine Biological Laboratory is one of the most notable of these associations. It would seem most natural that the Carnegie Institu-

tion should first of all take advantage of the existing organizations for research without destroying their independence, and it would also follow that it might properly aid in the opening up of fields of work hitherto not so well supplied with opportunities for investigation. National societies representing well-defined territories of scientific endeavor might well be asked to appoint a 'Committee on Research' whose function it should be to represent the society in conference with the authorities of the Carnegie Institution, and perhaps to suggest not merely the nature of assistance it is desirable to render to the individual investigators that it represents, but to formulate plans for a comprehensive and protracted study of definite fundamental problems.

It would seem as if existing agencies for promoting research should be fully utilized before any attempt is made to create another organization. These agencies may be found in and directed through the several national societies whose avowed aim is the promotion of research. Practically all the workers in the different natural sciences are organized in some way, and while the details of the organization are quite different, the controlling purpose is the same. In some sciences the number of societies is excessive and illustrates the national tendency toward multiplication of executive mechanism, but, as is well known, various plans for unification and centralization are even now being considered. By inviting the cooperation and advice of these societies of national scope and by stimulating their activities the solidarity of scientific organization will be increased and enthusiasm for research greatly stimulated. More would probably be accomplished in this way than by adding another set of wheels to the existing machinery for transacting scientific business.

Edwin O. Jordan.

In complying with the request of the editor of Science for an expression of opinion regarding the work of the Carnegie Institution, I must speak solely from the standpoint of my own specialty, though possibly the suggestions are capable of a wider application.

First of all, it is important that the funds of this great donation should be utilized for the furtherance of work which cannot be accomplished in any other way. Secondly, it is understood that these funds are to be used primarily for the furtherance of research.

What is the greatest hindrance to chemical research in this country? There go out from our different universities each year men well equipped for research, and this number is increased by others returning from German and other foreign universities. After perhaps the publication of a résumé of their theses, little is heard from most of these men, yet many of them have begun the study of interesting problems. The reason for this is not far to seek. Those who have entered upon a career of teaching have found themselves so burdened with class-room work that they have neither time nor energy for continuing their researches. In many positions research work means to the trustees that the teacher is not devoting the time he should to his classes. In a comparatively few institutions there are positions as assistant, where a man has time for research and is possibly expected to engage in it, but such positions are generally temporary, and the incumbent, if successful, is soon promoted to a place where he receives adequate salary and spends most, if not all, his time in teaching. Every chemist will recall numerous examples of men who have given great promise, but have soon had a quietus put upon their research work. There are comparatively few teachers in this country so situated that

they can carry on such work, and still fewer who are in a position to direct such work, for it must be borne in mind that if one man has to carry out all the manipulation of a line of research, it will of necessity be rather limited in its scope.

These conditions it is practically impossible for most of the universities of the country to improve, limited as they are in their funds. Would it not accomplish the aims of the donor if a portion of the income of the Carnegie funds were used as fellowships, which would enable men who had already given good promise to go on with their work at some university of their choice, the income from the fellowships being large enough to support them adequately, and being renewable for several years if deemed wise in individual instances? In some cases it might be well to award these fellowships to older men, that they might be enabled to employ assistants to carry out lines of research, which it would be an impossibility for them to accomplish alone on account of their pedagogical duties. Many a teacher of chemistry could bring forth valuable results if he had an assistant to carry on manipulations, for which he himself cannot find the time. As far as I know, none of the research funds now available could be legitimately used for the purpose of employing assistants.

There is another direction in which the Carnegie committee on research in chemistry, should such be appointed, could render valuable aid to the cause of chemical research, and that without the expenditure of any considerable sum beyond their own salaries. This is in pointing out desirable directions of research. Many young men, just starting on their careers as teachers, are anxious to take up some line of investigation but do not know just what to select. On the other hand, there are many lines upon which it is desirable that work should be done, with no one to undertake it. Such a committee could render invaluable service by acting as a sort of *chemical research clearing-house*. The whole field of inorganic chemistry, for example, is full of gaps which need to be filled out, as well as of old material which needs to be reexamined. Professor F. W. Clarke has elsewhere called attention to the assistance which could be rendered by a suitable committee in this direction. It would doubtless secure the immediate cooperation of scores of young chemists, and the possibilities in this direction are almost limitless. I am well aware of the fact that there must be a spontaneity about research, but nine young men out of ten will be wisely guided by older heads when setting out upon a career of investigation.

There is one other direction in which a portion of the Carnegie funds might be turned, with the assurance of accomplishing much for chemical research. This is the establishment of an American counterpart of the Davy-Faraday Research Laboratory of the Royal Institution, and its adequate endowment. This would, however, probably require more than the proportion of the funds that should justly be allotted to chemistry, unless the province of the Institution should be confined to a few sciences only; but its value would be unquestionable.

J. L. HOWE.

IN my opinion the final policy of the Carnegie Institution can only develop with time, and at the outset a tentative plan should be adopted which would not involve the investment of a considerable sum in a working plant of any kind, and especially in duplicating plants already in existence. I would, therefore, suggest that for the present the income be devoted mainly to subsidizing such researches and such investigators as seem to be worthy, utilizing

existing laboratories and cooperating with existing institutions for the purpose. It would then be possible to modify the plan at any time without loss, if the erection of special buildings or laboratories should appear desirable.

From the statistics of doctorates conferred during the past five years (SCIENCE, Sept. 5, 1902, p. 363) it appears that twice as many degrees were given in chemistry (137) as in any other subject, physics following with 68. We certainly have now enough chemical and physical laboratories to meet present requirements, and money expended in these sciences should be devoted, not to equipping new ones, but rather in assisting existing ones to do better work, by aiding the purchase of apparatus and supplies (including books) with a view to special work, and in encouraging the most promising men to continue their investigations. Most of the new doctors will never again appear as producers of works of pure science, not always because of disinclination or incapacity, but because of the necessity of earning a living by devoting themselves to more profitable pursuits. Probably few scientific men work with the view of disinterestedly promoting science. More powerful motives are the desire of approbation and of wealth. The best men are quite as desirous as others of attaining social standing, and, as every one knows, social standing in this country depends not so much on what one does or attains, as on what one spends, and few men are so constituted that the pleasures of scientific discovery or the approbation of perhaps a dozen specialists is sufficient compensation for poverty and social neglect, and this feeling is likely to increase rather than diminish with advancing age.

The Carnegie Institution should, therefore, do as much as possible to render life socially endurable to the best investigators by offering liberal assistance, in the form either of salaries or of subsidies for investigation, with the understanding that they are to accept no expert work requiring much time, and conduct no researches the results of which are not to become public property, and then only when it is clear that they would otherwise be driven to other occupations. The awarding substantial prizes for good work would afford a further means of encouraging research, care being taken that it does not lead to duplication, as may happen when special problems are proposed for solution. Of course all immediately practical problems for the solution of which there exists a sufficient financial inducement should be avoided.

With regard to publication, my opinion is that no encouragement whatever should be given to such composite publications as the Proceedings of Academies, or those college or university journals of mixed character, the object of which is clearly to advertise the institutions at the expense of a wide circulation of the results among specialists concerned. These have their own reward. The publication of monographs might well be undertaken, and assistance given to special journals in the case of meritorious papers which would clearly otherwise go unpublished. The establishment of a printing and engraving plant, however, would seem inadvisable at present, for reasons given above.

The organization and direction of research, while offering a field of usefulness, might easily be carried too far. The best scientific minds are intensely individualistic, and the attempt to place a really original investigator under the direction of another man would only result in detriment to his work. Unless, therefore, it should clearly appear in any case that direction is indispensable the institution should limit itself to bringing investigators

together for the purpose of deciding the nature of the most important problems to be attacked, and the best men to undertake the work, but beyond affording the means it should leave them with as little supervision as possible, judging them by the results.

In conclusion, I heartily concur with other writers as to the desirability of especially encouraging work in the hygienic sciences, psychology, physical and chemical geology and other subjects which have as yet obtained but little foothold in our educational institutions.

H. N. STOKES.

U. S. GEOLOGICAL SURVEY.

I THINK that Professor Cattell has done a public service in setting forth at length his views of the best ways to employ Mr. Carnegie's gift. I thoroughly agree with the two general principles he lays down: (1) That the institution must work in harmony with existing establishments, and (2) that it should aim to improve the condition of men of science, working with them and through them. We want no popes in science, nor any councils of ten with supreme power. The past history of some of our scientific societies and the present pretensions of some of our too-numerous scientific congresses show what is to be avoided. First of all let the man of science be free. Then assist him if you can. To the paragraph beginning 'I should like to see at Washington a Carnegie Institution somewhat on the plan of the Royal Institution of London' I give assent qualified by the remark that the Smithsonian Institution should do the work proposed, and gain the time for it by giving up its grip on the National Museum, the Zoological Park, and the Bureau of Ethnology. Its proper business is to assist those institutions when it can, not to petrify them into units of a rigid administrative machine. The Carnegie funds would provide the necessary income, building, etc.; the slight administrative machinery needed should be the work of the Smithsonian Institution clerks. The secretary of the institution should be, ex officio, a member of the board of managers with a voice and one vote. The salary of the members need not be above $1,000 per year—just enough to pay their travelling expenses, hotel bills, and a reasonable fee for their lectures, etc.

The suggestion as to the establishment of an endowed scientific press seems to be admirably adapted to cure abuses which have long existed and especially to stimulate the prompt publication of first-class work. Provision should be made to assist the printing of original work, as is now done by the Oxford authorities, etc.

A small addition to the income of an establishment will often produce results that are out of all proportion to the amount. For instance, the gift of even $1,000 a year to the Lick Observatory funds in 1886–97 would have made many rough places smooth. A single computer added to the staff would have relieved our best men from much drudgery and left them free to do the work for which they were fitted. Subsidies should be given to astronomical observatories already established; and they should be given only for a limited term of years—during good behaviour. If after a reasonable time the subsidies produced little or nothing they should be discontinued. The very best way to assist research in astronomy is to pay salaries to young astronomers. An effective form of assistance is to establish fellowships with incomes of $1,000 or less.

Small grants in aid of the publications of worthy scientific societies or journals would have an immediate and far-reaching effect.

If a plan can be devised to utilize men of talent or genius, 'who for some reason or

other have not found a place in our social machinery' great things might follow. We all know such men. What might not come from some of them if their lives were made a little easier?

Perhaps the foregoing sentences may serve a useful purpose in emphasizing Professor Cattell's proposals. If the two general principles he lays down are frankly adopted and adhered to, most of the rest of the business will be a matter of detail.

Edward S. Holden.

U. S. Military Academy,
West Point, Sept. 15, 1902.

Editor of Science: I have read your suggestions on the Carnegie Institution with much interest, but my thought does not run in the same line with your own. All that you say is true about the lack of support to the development of abstract science, but in one way or another the man who possesses the capacity to develop science along the lines of the highest investigation finds the way to do it. True, it may be like many inventors, he cannot stop if he tries to. In the end he works out the results.

However or by whom begun in very many branches of applied science and invention, the work gets done, either in spite of or by means of patent laws, which I am inclined to think rather retard than promote invention. The practical application of scientific methods to arts that pay large profits works out in some way; often the inventor gets little or nothing, the promoters get all, but the community has the benefit of the invention.

According to my observation, there is a middle term in which there is an enormous gap which neither inventor, promoter nor the masters of higher branches of science have attempted to fill. A great amount of mental energy has been given to the development of the steam-engine, and yet the steam-engine is the most wasteful machine now in existence; until lately we have been far behind in the gas-engine. Invention has been given to cooking apparatus, yet the waste of food and fuel is the biggest waste of the whole country. Invention has been applied to providing all the apparatus for extinguishing fire, and yet the fire waste of this country is a disgrace to the nation.

I attribute this fire waste in large measure to ignorance, stupidity and criminal negligence on the part of the owners, builders and architects of existing buildings. I have chosen that line in extending the application of science to the Prevention of Loss by Fire, as will duly appear in the documents which I send you under separate cover. But there is another line hardly yet touched, to which, in my judgment, the attention of the trustees of the Carnegie fund might well be called.

Invention has been applied to the fullest extent to the development of agricultural implements and to the working of the soil; but is not the art of using the soil itself as a mere instrument of production rather than as a mine subject to exhaustion, yet in its infancy? We have but lately learned, almost by accident, the power of certain plants to draw nitrogen from the atmosphere. We know as yet but little about hybridizing food plants, although we know a great deal about the development of fancy flowers by that method. We know in this country but little about the cross-breeding of sheep. The waste of skimmed milk is something enormous, and the excellent food property of cooked skim cheese common in Italy is almost unknown to us.

The beginnings have been made in a quiet way; the agricultural experiment stations of the country have grown up almost unbeknown to the mass of the people. They occupy an anomalous condition, partly supported by the National

Government, partly by the States, often by auxiliaries, colleges or universities. I think there is no body of men performing so great service as the experts connected with many of these agricultural experiment stations. I have had occasion to correspond with them in dealing with the wheat supply and the cotton supply of the country, and in making an effort to get the people of the Piedmont plateau and of the Atlantic Cotton States to renovate their soil by pasturing sheep upon the cotton field, admitted to be feasible, were it not for the cur-dog; where there is not sufficient intelligence to muzzle the cur-dog it is hopeless to expect any intelligent method of agriculture of any kind that can be widely extended. In my judgment one of the greatest services that managers of the Carnegie fund could work at would be aiding those agricultural stations in which the best work has been done. There are two by which the whole standard of dairy products of their respective states has been raised to a very high point; one or two in which varieties of Indian corn have been generated containing as much or a larger element of protein than is found in the average of wheat.

Another, where the production of sugar has been dealt with, whether any efforts have been made to hybridize sugar-cane and maize, I know not. A very moderate aid, especially in the matter of laboratory and libraries, might be of immense service in guiding the revolution in agriculture of this country which is now going on; mainly from extensive ignorant dealing with the soil as a mine subject to exhaustion, to an intelligent and intensive method of using the soil as an instrument of production, responding in its abundant yield in just proportion to the measure of mental energy and practical skill that may be applied to it.

If you think this missive will be of any service, you are at liberty to print it.

EDWARD ATKINSON.

EDITOR OF SCIENCE: Your letter of September 8 asking an expression of opinion as to the most effective way in which the Carnegie Institution can contribute to the advancement of science, has just reached me in the North Woods, where I am spending my vacation.

The question which you suggest, and which is now before the trustees of the Institution, appeals strongly to all men who have at heart the advancement of science, and I suppose that all such have given the subject some thought. So far as I have been able to consider it, my thinking has led toward the following conclusions.

I understand the purpose of the Carnegie Institution to be the promotion of scientific research. At the present moment three directions seem to me open to the Institution, along which it may proceed to carry out its purpose:

1. By establishing and maintaining, under the direction of the trustees, an institution devoted to research.

2. By assisting men in universities, colleges and other existing institutions to carry to conclusion researches already begun or planned.

3. By seeking out men of extraordinary ability, outside of regular institutions, and putting them in the way to conduct researches or to perfect discoveries.

Of these three methods of procedure the first is the direct one. My own experience in the scientific work of the Government and of private institutions of learning long ago led me to think that an institution in Washington, modeled somewhat after the Royal Institution, and independent of government support, would have a great opportunity for usefulness. Should the Carnegie Institution provide such an es-

tablishment, and bring to it a limited number of the ablest investigators and student assistants, it would thereby give, in my judgment, the most direct and powerful stimulus to research which could be rendered.

The promotion of research by assisting investigators in existing institutions constitutes a means which will doubtless receive the most careful consideration at the hands of those who direct the Carnegie Institution. Undoubtedly great possibilities for stimulating research are to be found in our universities and colleges. Nevertheless the wise use of funds in this way is beset with many difficulties. In most American institutions of learning the conditions which obtain are not favorable to the development of the research spirit, and it would be entirely possible to expend the entire income of the Carnegie Institution in this way and obtain no other results than those of a mediocre and routine nature. In no other direction will the managers of the Institution be called upon for a greater measure of that good judgment which couples keen discrimination with sympathetic appreciation, than in their endeavor to assist research in existing institutions.

The third line of activity to which I have alluded has its peculiar difficulties also, though of a different sort from those just referred to.

An institution founded for the promotion of research will not be content to get in touch only with those already fairly known and started in the work of investigation. It will seek to introduce the new sciences as well as to stimulate the old to new triumphs. It will desire to discover the discoverer, to keep a door always accessible to the unknown and obscure investigator. By such a door an army of cranks will seek to enter, but so also will the unheralded genius. Now and then a Thomson, an Edison or a Marconi will knock for admission; mayhap a Henry or a Pasteur. It is here—in the endeavor to come in touch with the unknown struggling man of genius—that those who direct the Institution will find at the same time their keenest disappointments and their greatest successes; and here again is a wise sympathy no less needed than a keen scrutiny.

Of the three plans of procedure here suggested the first is, to my thinking, the prop and the inspiration of the other two.

If the Carnegie Institution succeeds not only in bringing to accomplishment certain useful researches, but also in awakening the spirit of research itself, its success will have momentous consequences for the whole world. No other project has at this moment so fully the attention of all men of science. In their effort to execute the delicate and important task committed to them the directors of the Institution are sure to receive the cordial cooperation, as they already have the keen attention, of those who are interested in science and in the progress of men.

Henry S. Pritchett.

MEMBERSHIP OF THE AMERICAN ASSOCIATION.

The following is a list of persons who have completed membership in the Association during August, 1902.

Thos. L. Armitage, M.D., Physician and Surgeon, Princeton, Minn.

Oscar P. Austin, Chief of Bureau of Statistics, Treasury Department, Washington, D. C.

Theodore Baker, Box 44, Haskell, N. J.

Howard J. Banker, Professor of Biology, Southwestern Normal School, California, Pa.

John Barlow, State College, Kingston, R. I.

John E. Best, M.D., Physician, Arlington Heights, Ill.

Mrs. Josephine Hall Bishop, 2309 Washington St., San Francisco, Cal.

James Hall Bishop, 2309 Washington St., San Francisco, Cal.

Anson W. Burchard, 44 Broad St., New York City.