Schenectady, December 9, 1918.

Subject: Laboratories.

Mr. F. C. Pratt,
ASSISTANT TO THE PRESIDENT,
Building No. 2.

Dear Mr. Pratt:-

There are two fairly distinct fields of laboratory work in connection with the activities of the General Electric Company. (1) Research Work, which term is, in general, applicable to investigations leading to fundamental discoveries and to a better understanding of basic principles. (2) Engineering work, which term is in general applicable to inventions and developmental work which results in the production of models or samples of apparatus or machinery which may in turn be passed on to some manufacturing department to be built and sold.

In the engineering field may also be included the development of methods for testing to be used in connection with manufacture, development, and research work as well as the creation of instruments and devices for testing and measurement, both to be manufactured and sold and to be used to meet special requirements in the Company's work where no existing apparatus can be readily purchased which meets the requirements fully. It has been found advisable, also to manufacture in such a department apparatus for sale when the total required is too small or the devices are too complicated to permit of a sufficient commercial return to justify the space and cost of adequate tool equipment to manufacture in accordance with methods recognized as suitable where low cost is

demanded.

More closely related to the engineering laboratory work than to any other is the work in connection with maintaining standards to be used in testing apparatus and verifying instruments, meters, etc. That is - standards of current, voltage, power, magnetism, etc. This is a very important branch of laboratory work but it is not of general interest. Adequate arrangements to take care of this have been made available from time to time as needs arise but beyond mentioning the fact that this standardizing work must necessarily be a considerable part of the activities of an engineering laboratory it will not be referred to further. The research work is also well provided for.

The dividing line between the proper functions of a research laboratory and of an engineering laboratory must remain very indefinite and could be given a very different location if drawn by different individuals. There is no need to discuss this point because this very indefiniteness is an advantage rather than a disadvantage. It provides enough overlapping points of contact to keep an active interest in both branches in the work of the other branch so that many things have been started in one place and finished in the other or have been carried from conception to completion by mutual agreement and cooperative effort. The present arrangements are so altogether satisfactory in this respect that I do not think they need be referred to further.

Considering a little more in detail what an engineering laboratory should be, it should do work for engineers, departments,

and customers operating entirely as a contributing department; that is - accepting a given piece of work as outlined by the one wanting the work done and carried through to conclusion in almost the same way that an article would be manufactured. Such procedure is of advantage to the Company because of the fact that many such investigations require expensive mechanical and electrical equipment and testing facilities of a special nature beyond what could reasonably be provided for separate departments or even separate factories.

As opposed to working in this way many developments have been carried out and more could be undertaken with profit which were initiated by the laboratory staff based on ideas and needs which occur to them by reason of their general experience. Such developments usually relate to devices that are more in advance of present time needs than the class referred to in which the Laboratory is only a contributing department. Between these two extremes is the largest and probably the most useful field where some one outside of the laboratory organization is interested to a more or less degree in cooperating with the laboratory force.

At the present time this engineering development work of the kind that could be best done in a laboratory is more scattered than it should be.

I feel that in general the results obtained are quite worth while but a more unified arrangement would no doubt give better results and allow of more being accomplished with the same building space, men and expenditure as are now allotted to the

work. There is also some overlapping of effort which could, to a large extent, be avoided.

The engineering development work which has been a considerable part of the work of the Standardizing Laboratory is of the same general nature as most of the work which has been undertaken by the Consulting Engineering Laboratory although the handling of the work in the two places is quite different. In the Standardizing Laboratory we have, for the most part, arranged apparatus to meet general requirements and have a staff who can cover fairly well the whole field of electrical engineering. We have very little equipment that has been arranged to do a specific piece of work and for the most part whatever we undertake is not done all in one place or by one man. The result of such an arrangement is a high degree of flexibility in the outfit and the avoiding of the necessity of spending considerable sums of money to arrange equipment to do specific jobs. With such an arrangement it is not always possible to assign a given accomplishment definitely to a certain man but on the whole the arrangement seems fairly satisfactory. With few exceptions the same general problems are before us now that were before us several years ago and this is likely to be the case for some time to come.

In the Consulting Engineering Laboratory there has been more of a tendency to confine the work of an individual to a certain specific development and to provide equipment for this work. This method certainly requires very much more floor space and a greater expenditure for apparatus which, after the specific development is completed, is not always useful for general purposes or for

undertaking other developments. The results obtained in this way however, have been in general good and it may be that both schemes of working have enough merit so that they should both be continued and perhaps the procedure in each laboratory should, to some extent, be modified by the experience gained in the other.

The question of keeping track of the expenditures on different developments is also of importance and here again the two methods are different. In Building 5 the plan followed has been to take care of this work entirely by a clerical force outside of the development workers while in Building 28 each worker is required to give a portion of his time to the preparation of weekly reports of expenditures as well as progress. The results which have been obtained in Building 28 in using this method are, I feel, satisfactory as far as the results themselves go but I feel that if such an arrangement is insisted on, as I understand that it has been, that the choice of assistants is limited to those who can and are willing to work in this way. In some cases this is a severe handicap because in my own experience I have found that many good laboratory men to work on development work do not have the type of mind that can be brought to bear successfully on the administrative or accounting end of affairs unless we are willing to pay much more for the work than is necessary to secure men having sufficient technical and scientific ability. In this important particular also I feel that a combination of the good points in both places and the rejection of some bad features would be of distinct advantage.

It is also of importance to secure proper recording and filing of the detailed results of all work carried out. In this respect the procedure in the Standardizing Laboratory is much more complete and I think should be considerably expanded. In fact I think the whole subject is one of such importance that the Publication Bureau should organize a uniform system for all laboratories and that the carrying out of such a scheme should be unfformly insisted upon. When a development results in something satisfactory we, of course, have the result for manufacture or for use but many of the methods used and the partial results accomplished are lost sight of; also the proper recording and filing of the results of failures would prevent later experimenters from experiencing the same difficulties. In fact I think that good records and reports are of paramount importance because in any large organization about all we can get to represent the expenditures for many pieces of work is the record and report and if this is not properly done and clearly written much effort has been lost. More complete attention to this part of the work allows publication of results at any time without undue time being given to their preparation forissue, also circulation of information within the Company is facilitated.

With regard to the mechanical work done in an engineering laboratory this feature should be developed to the fullest extent. We should be able to produce samples rather than crude models so that when work is turned over for manufacture it would not require much if any development by the mamufacturing department.

Another branch of the work which has not been specifically referred to is the testing of samples of completed, new or old standards apparatus with a view of discovering faults instead of allowing these to be discovered in most cases by users of the apparatus. Considerable work has been done along this line but I think it could with profit to the Company be expanded considerably and should cover appearance and mechanical features as well as efficiency and general performance.

All the foregoing is simply recording some of the thoughts that passed through my own mind and which I have written simply with the idea of supplementing what you already know of the general situation toget the problem clearly before you.

The question now is how can the organizations and equipments which we now have be best utilized for the general good? I feel that this work should all be tied together in some way but in such a way that individual initiative will suffer only a minimum of restriction and so that all factories and engineering departments as well as independent consulting engineers, particularly Dr. Steinmentz, will have unquestioned confidence in the capabilities and integrity of the laboratories. The individual workers should have a minimum of supervision and a maximum of freedom to work with all departments and engineers as far as possible. On the other-hand it would be desirable to have the needs of these same departments and engineers taken care of in each case by the laboratory and must be fitted to do the work and above all the advice of the general and consulting engineers should be made available to all the laboratories without preference.

One possible arrangement for carrying on this work would be quite similar to the present one, that is to have several practically separate laboratories of more or less magnitude and breadth of endeavor all working independently some of them reporting in such a way that the information is not available at all or not generally accessible each group dealing with yourself directly in the matter of obtaining appropriations for the work, equipment, etc.

I believe the present arrangement is so evidently unsatisfactory that it need not be considered further except in the event no other arrangement can be proposed which gives enough promise of being successful in operation to be tried.

The best recommendation that I can give, after carefully considering the case for sometime, is that all the engineering laboratory work at Schenectady should be placed under one general management with authority to supervise the work and to execute what is agreed on as proper work to be undertaken. There should be formed an engineering laboratory committee to meet at regular intervals to recommend appropriations for carrying on the work and to outline broadly the work to be done and to review the progress of this work. Also to consider and to pass on appropriations for equipment, personnel, etc., and to establish uniform systems of records and accounts. Such an arrangement, I think, should be perfectly satisfactory to everyone interested and under such an arrangement we could, I think, retain the enthusiastic services of all the present individuals involved.

The Consulting Engineering Department should be represen-

ted on this committee, I hope in the person of Dr. Steinmetz, and other interested departments should also have representation. I should like to see Mr. Hayden made secretary of this committee and give all of his time to looking after the work in the laboratories.

Such an arrangement would remove the possibility of concentrating too much power in the individual who directs the work and confine his efforts to carrying out what they agreed on in the committee as proper work to be undertaken.

The Consulting Engineering Department should be divorced from the direct management of any laboratory but in common with other interested departments would be represented on the laboratory committee. In common with other departments they will be kept closely in touch with the work through the secretary who would also become, in fact, executive assistant to the manager of the engineering laboratories. This should, I think, be a satisfactory solution of the problem as far as Mr. Hayden is concerned. It would result in a considerable broadening of his scope rather than in a restriction of it. He would remain closely in touch with the Consulting Engineering Department but not of it as now.

I realize that this recommendation is incomplete but I hope that you will feel that this review has brought the matter up to a point where it can be effectively discussed and settled.

Very truly yours,

L/R:WSB

Standardizing Laboratory.