

SCIENCE

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INDUSTRIAL RESEARCH IN SMALL ESTABLISHMENTS

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IN the past few years, and particularly during the war, research in connection with industry has had much consideration. Most of our large technical societies have devoted sessions to its discussion and have listened to admirable papers on the subject. I hope not to retrace the ground thus covered. In this audience the vital importance of research to our technical industries would not need arguing even if it had not been amply argued. In these discussions research has been considered as something to be carried on in large well-organized laboratories, and for that reason possible only for large companies, for associated companies managing a cooperative laboratory or for government laboratories and the like. I believe that this way of thinking of research unnecessarily restricts it, and that differently conceived its usefulness to small as well as large establishments would become evident and might result in its large extension.

The various activities covered by such titles as "Research, Development and Technical Control" are those which should be assumed by a research department in a small business. In order to avoid a cumbersome name for such a department, I want to make a plea for a definition of technical research which some of you may think degrading. Doubtless you are accustomed to thinking of research as an adventure into the realms of the absolutely unknown. A department capable of research in this sense will only be possible in a small business when that business happens to have in it a real scientist. But every technical business (and what manufacturing business is not technical?) is continually confronted with the need of more information than is possessed by its regular staff in regard to processes, characteristics of materials, etc., and if it is to develop realizes that it must find new fields for

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its product and find new products to sell. The most advantageous solution of problems of this character can not be left to people who are busied with the routine problems of sales and production. They can best be handled by a staff, even if a very small one, set aside for this purpose. I want to suggest that any department having such functions may be called a research department, and that industrial research may be defined for any given establishment as all that class of work which enlarges the technical horizon of the establishment beyond what is necessary for the routine production and test of its product. You will note that this will make a sharp distinction between a research laboratory and a testing laboratory. I should not want to see a chemical laboratory, however large and elaborate its equipment or however highly trained its staff might be, called a research laboratory if its sole function happened to be routine analysis and check on the product. On the other hand, I should like to see any little room with even a very meager equipment and staff, perhaps only a single individual, called a research laboratory provided the functions of that individual and equipment were solely the improvement of processes, investigation of properties of materials new to the industry, development of new products, etc. And I should want to have it called a research department even if the research be chiefly carried on in libraries or other places for the purpose of bringing information, elsewhere well known, to an establishment to which that information happens to be new. This conception of research widely recognized might be the occasion for many small industries to start research departments, which these industries now regard as possible only for large capital. In this sense many small industries already have individuals with research functions who have other duties as well and do not clearly recognize their research functions. Under these circumstances both the research and the other work suffer, and as the business develops research does not find the best relation to the work as a whole.

Research, development and technical control merge into each other at many points, and in

all but very large establishments can probably best be carried on by a group working under one head. Why attempt lines of demarcation?

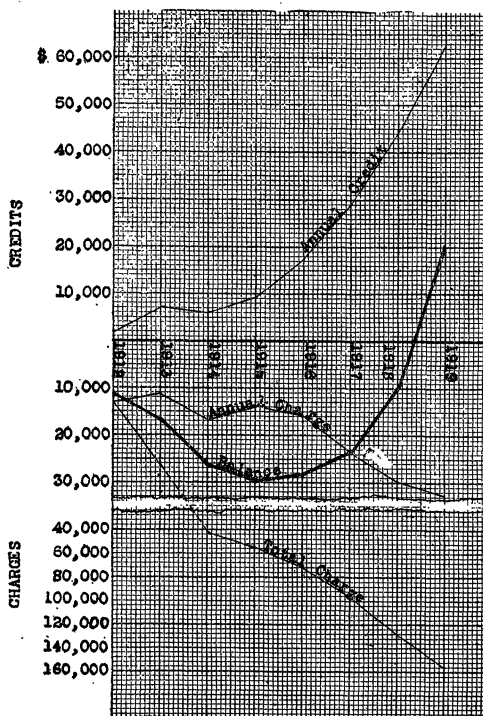
In order that research may find its fixed and recognized place in industry it is desirable that it be carefully planned and controlled, and that its results be carefully watched. So far as I know, these two conditions of the successful coordination of research with industry have not been discussed. Control in the sense of control of the research in the laboratory after it has been decided on has had discussion, and I do not refer to it but to the determination of the subjects which shall be investigated in the research department and the decision as to when the research is completed, or, in case it is one that does not lead to satisfactory results, when it shall be abandoned. For some five or six years this class of decisions in connection with our research department has been made by a committee of which the president of the company, the head of the research department, and representatives of the sales, engineering and production departments are members. This committee, called the research committee, meets once in two weeks, passes on all new subjects for the research department to handle, listens to reports on the progress of the work in hand and passes on recommendations in regard to the conclusion or discontinuance of work. In this way the work of the research department is well coordinated with the needs of the business as a whole. As a further factor in coordination the head of the research department is one of the board of directors and sits on the executive committee. The research committee has nothing to do with the internal administration of the department, which is left entirely to its own staff.

Records of the results of a research department can best be kept by the accounting department. It is just as important to know the cost of research as of any other department, and, as in other cases, the usefulness of the record depends to a very large extent on its subdivision. It is worth while to know what investigations contribute to business success and what ones do not.

Some years ago we worked out a plan of determining research cost and making credits to the department which has given us much valuable information. Each investigation undertaken has its cost record kept by the accounting department in the same way that a production order has. We of course do not ask our research men to register their time on a time clock or anything of that kind, but we do ask them to make a memorandum of the work on which they spend their time and turn in to the accounting department once a week a statement of the distribution of their time over the orders running in the department. Similarly, expenses and costs of materials are kept, and when an investigation is closed its total cost is determined. If it happens to be one that has to do with manufacturing processes, such as test of new materials, etc., or development of new methods, it is either charged to general expense or to the expense of some particular product. If, however, it is a piece of work which results in the development of a new instrument or product for sale, it is treated in the same way that a new instrument developed and brought in by an outsider would be. The research committee decides how much royalty can properly be charged to the cost of the instrument, and then as each instrument is made the royalty is added to its cost and is credited against its cost account in the research department. In that way a continuous record of the usefulness of the research to the business is available. In cases of minor importance it is customary to discontinue credits when the cost has been covered. In cases where new products result they are allowed to run on indefinitely. Successful developments accumulate royalties that more than pay for the cost of their research and offset the costs of work that leads to nothing. The diagram shows the relation of annual and accumulated costs of research to the annual and accumulated credits since the department was given a distinct place. In a little over six years the total credits had equalled the total charges and the balance went to the credit side. On the books the account is closed out each year to profit and loss. It is carried

forward as a memorandum account only. In the earlier years of the record the total volume of business done by the company was but a few hundred thousand dollars per year.

To summarize, I am making a plea for a



conception and organization of research which will allow it to emerge as a distinct department in any growing technical business and take its proper place just as sales, production and accounting do. Any technical business ambitious to grow and render worthy service must in some way avail itself of research. Kenneth Mees and others have pointed out how industry in the past has developed around invention and research, although the distinctiveness of these functions was not clearly recognized, and in many cases they were not directly associated with the business which profited by them. Certainly an enterprise will have a more worthy and normal growth if its need for research is early and clearly recognized, and the research department will more easily find its proper relation to the business as a whole if it is established early and its place and functions are defined.

After a business has assumed large proportions, and research functions are distributed in scattered manufacturing and engineering departments, it is difficult to gather them together and coordinate them.

Let me remind those of you who may think this conception of research degrading that the present scientific limitation of the word is modern and confined to the exact sciences. The Century Dictionary gives its definitions in this order:

1. Diligent inquiry, examination or study,
 2. Laborious or continued search after facts or principles,
 3. Investigation,
- and quotes from Cowper

He sucks intelligence in every clime
And spreads the honey of his deep research
At his return—a rich repast for me,

so I think that the definition which I propose does not violate good usage. Even if it did would not the possibilities of development and usefulness to industry which this definition allows justify it in the same way that Bryce, in his "American Commonwealth," writing of the third quarter of the last century, said that the application of the name "university" to many institutions, which were no more than colleges or in some cases high schools, was a favorable sign because it showed an aspiration, and that where the aspiration existed the reality would follow? We all know to what a large extent this forecast has come true.

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THE NATURALIST'S PLACE IN HIS COMMUNITY¹

BEFORE beginning discussion I may say that I am not trying to say anything new or original and that I am not quite sure that I shall be able to make myself entirely clear in the limited time at my disposal. I do think, however, that the points which I shall men-

tion should be more often opened to serious consideration.

Inasmuch as there are probably about as many different notions of "naturalist" as there are users of the word it may be necessary to say that by this term I now mean any one who is actively interested in living things as such.

In primitive societies most of the leaders are naturalists. In fact in most cases their leadership depends on attainments of that sort. The medicine man gains and holds his position very largely through his shifty use of knowledge of certain characteristics of animals in general and of his fellows in particular. The chieftain also usually bases his influence on successes derived from familiarity with activities of all sorts of animals. Certain women may gain indulgence or even general respect through exceptional familiarity with medicinal and food values of great numbers of plants and animals. It is, of course, easy to see that primitive leadership is thus conditioned because primitive man is individually in contact with the natural environment and appreciative of its mysteries; also because in an unspecialized social group all the members are sufficiently acquainted with every phase of activity to be able to understand and fairly to evaluate unusual skill and intelligence.

As society advances in complexity from the primitive stage and as more and more specialization occurs there are larger and larger numbers of individuals removed from natural to artificial conditions of existence. Not only so, but many of them are so far removed that they cease to have any knowledge of natural existence and so become entirely out of sympathy with those who retain some contact with and some interest in the natural order of things. This remoteness from nature may be physical as in the city dweller, or mental as in the rural resident who sees nothing but a pecuniary return through manipulation of same natural object. Thus it happens that the abilities of the naturalist tend to be obscured, ignored or derided in a complex society. His standing amongst his fellows is reduced to the lowest rank and his influence

¹ Read at the meeting of the Bay Section of the Western Society of Naturalists, Stanford University, November 29, 1918.