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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE ORGANIZATION OF SCIENTIFIC RESEARCH IN INDUSTRY[1]

FINDING AND ENCOURAGEMENT OF COMPETENT MEN

TWENTY-FIVE years of doing, finding and encouraging others to do scientific research in industry, and of organizing the machinery for the smooth and effective conduct of such research, have left me with a feeling that so far as this branch of human activity is concerned the problems in essence are not materially different from those met elsewhere. Years ago, in a less mature period of life, I may have thought that the effective industrial research man was a being somewhat different from his fellow workers in adjacent fields. I may have thought that some peculiar slant of mind, some slightly different outlook on life or some special appraisement of relative values branded him with a distinguishing hallmark that designated him unescapably for special treatment and special relationship in the industrial environment.

If such ideas were ever mine, I have long since outgrown them. My present view is that except in those details which are the direct consequence of a particular function, the problem of finding and encouraging competent men in industrial research is in no substantial measure different from the finding and encouragement of competent men in any walk of life. If this conclusion is correct, the subject I have been asked to discuss narrows itself down to a consideration of the things which distinguish achievement in industrial research from achievement elsewhere.

In any discussion of this sort one must have clearly in mind at the outset that which we wish to consider. I take it that we are not here concerned with the finding and encouragement of the rank and file of those who do a fair day's work for a fair day's pay in the field of industrial research, nor even with those who do somewhat more than a fair day's work for a fair day's pay. I take it that we are considering what the title of the subject implies, namely, the finding and encouragement of competent men, that is, men competent in a creative sense or competent in

[1] Symposium before Section M, Engineering, American Association for the Advancement of Science, New York, December 29, 1928.

those characteristics of administrative ability which make them fit leaders of industrial research groups or organizations. It is to these men, relatively few in number, to whom we must look for those substantial results which in the last analysis will be the justification for industrial research as we have come to understand it. Without them the term "industrial research" is merely the designation of a shallow thing of little present and no prospective worth.

The rank and file of the modern industrial research organization are relatively easy to find, though sometimes difficult to get in sufficient numbers. Mistakes in choosing them are not particularly serious to the organization, however unfortunate they may be for the misplaced individual who persists too long in the wrong environment. The reason for this is obvious from the fact that, taken by and large, the work of the rank and file is at best necessarily a work of detail done under guidance of the more experienced. In this respect the situation of the rank and file in an industrial research organization is not different from that of the rank and file in any other group activity, whether concerned with industry, the university or the church.

This does not mean, however, that we are not all anxious to have the best possible material obtainable in the rank and file, or that we are indifferent to the utmost of encouragement and stimulation to its individual members. We want to see each and every one make the most that he or she can out of life. We rejoice at every individual advancement, even though at times that advancement takes the individual out of the organization of which he has hitherto been a part.

Coming now to the finding and encouragement of the group we have designated as "competent," what are the conditions that confront us? In some respects these conditions are easier than those surrounding other activities because they are concerned with narrower fields in which to search. In other respects they are more difficult because of the very narrowness of the field of choice.

I take it for granted that a man is essentially miscast and essentially a transient if he finds himself in a field of endeavor where the primary requisite for success is alien to the thing he most desires. Even if this desire is unrecognized by him at the start it will sooner or later develop, and either wean him away from his environment or leave him a dissatisfied and essentially unproductive member of a fraternity with which he is out of tune.

Put concretely, what I have in mind is that a man driven, let us say, by a zest for personal wealth and the things which personal wealth will buy, is essentially miscast if he embarks in a field which does not lead pretty directly to individual personal wealth. The occasional case of a man capable of turning the opportunities of an otherwise unpromising occupation to the advantage of an aspiration which would normally find its easiest accomplishment elsewhere is no refutation, I think, of this thesis. Wealth resulting directly or indirectly from one's work, on the other hand, may be and frequently is quite different from the desire to accumulate an individual fortune.

Or, take the case of the man whose greatest satisfaction is tied up with his desire to exercise power over his kind. He is in unhappy surroundings, momentarily at least, if perchance he finds himself engaged in an occupation the apex of whose success is, let us say, power over the force of nature.

In both pure science and industrial research the men who succeed will be, for the most part, those men in whom the element of curiosity about nature and her ways is a controlling urge. With similar desires and similar training, the forces which tend to place the individual in the pure science field or that of applied science will be those secondary influences concerned with the allurements of the academic surroundings, the desire to have one's work concretely useful, or some of the thousand and one minor factors of propinquity, heritage, environment or chance.

Except in a minor way, there is no large available reservoir in which we can fish for men of proven competency in industrial research. Here and there we may, if we are so minded, pick out a man who has won his spurs in the field of pure science and transplant him to our industrial research orchard, or we may on occasion avail ourselves of an opportunity to transfer a man of maturity from one part of the industrial research world to another. Neither of these processes is, however, of any considerable value in strengthening industrial research. The first is a questionable procedure, particularly if indulged in freely, since the price paid for a temporary advantage is the almost certain degradation of the ultimate supply of trained men and new fundamental knowledge. The second is a mere shuffling of the cards in the deck and in some cases is ethically objectionable.

To those of us who are concerned with the building up and perpetuation of industrial research groups to function effectively year in and year out, the problem of finding competent men boils down in the last analysis to our ability to find competent *young* men and, having found them, to bring them into the organization, provide them with the facilities and encouragements for growth, and ultimately to make leaders of them. For the most part our search leads always in the same direction, namely, to the institutions of learning and to the parts of those institutions where men are given advanced training in science.

Out of the youthful timber which we find here we must make our selection. Occasionally the choice is easy—more often hard. To know and appraise a man well one must live and work with him for a long period. For the most part we who are in search of men do not have this opportunity. We must rely on such casual tests as our experience leads us to think worth applying. We should in the main be able to eliminate those who have inadvertently chosen an uncongenial occupation and who even though temporarily inducted into the industrial research field will not continue there for long. We should likewise be able in many cases to eliminate those who while properly cast in the field of scientific research would nevertheless find the environment of the industrial research laboratory distasteful as compared with the atmosphere of the college or university. Occasionally but not always we may be able to eliminate the precocious but superficially brilliant youth. It is from the remainder, after these eliminations, that we must make our choice. That choice should be entrusted to men of experience and understanding.

In my twenty-five years of association with industrial research I have had occasion personally to select a great many men. In the main I think I have had somewhat more than average success in the selections. Some, however, have proved quite wrong. Looking back over this experience of successes and failures, it seems to me that in the majority of the successes final judgment was based about one third on my personal appraisement and about two thirds on the considered judgment of a baker's dozen or so of men in the academic world who had had a relatively long and intimate opportunity to observe the subject of choice. Per contra, in the majority of cases which were not successes I am inclined to think that too little attention was paid to the experienced judgment of those in the best position to know, or too much dependence was placed on the expressed opinion of those whose judgment I should have distrusted for any one of a number of reasons.

Summed up, therefore, I should say that in attempting to select young men who in later life will be successful in industrial research, a primary requisite is to come to know the wise men in our college, university and technical school faculties whose judgment applied to the young men they have instructed makes them a more efficient sieve than any casual outsider can hope to be. True, they may not be able to tell you that "X" or "Y" is suitable for your particular situation—that is a matter which you alone are in the best position to judge. They should, however, be able to give you substantial advice, not only as to character but as to the reasonable chance that the youthful evidences of ability are the early fruits of a substantial continuing harvest and not merely the exotic flowering of a hot-air plant or the reflections of a casual environment.

In the matter of encouragement there is I think but little to be said. In a general way we of industry can give encouragement which induces young men to choose aright in the selection of their college and university training. More specifically, when competent men come to us we can see to it that their surroundings, the conditions of their association with their fellows, and the tools with which they work, are congenial and adequate. Above all, we must see to it that a just recognition of their achievements is accorded them. While adequate monetary reward in the form of salary or otherwise is a necessary and very important part of the problem of encouragement, it is in many cases, beyond a certain point, less important to peace of mind and continued productivity than are the conditions of environment and of a sympathetic human understanding of things accomplished, of obstacles overcome or of problems to be struggled with.

Neither with respect to the matter of choice nor the problem of encouragement are there in the field of industrial research, more than elsewhere, any hard and fast rules which can be applied with machine-like precision. We are human beings dealing with other and, to a large extent, younger human beings. The constants and variables of our particular equations may differ, but they are still the same equations with which other groups in other fields are struggling to solve like problems. Our success or failure in the selection and encouragement of men in the industrial research field is to a large extent a test of our individual sapiency. If proof be needed that the problem is susceptible of solution in many ways, we have only to look about us to see how widely dissimilar in point of view, experience and method are the men who have unquestionably succeeded in building up effective industrial research organizations in many fields of applied science.

F. B. JEWETT

BELL TELEPHONE LABORATORIES,
AMERICAN TELEPHONE AND
TELEGRAPH COMPANY

ENCOURAGING COMPETENT MEN TO CONTINUE IN RESEARCH

MAN has been researching for at least two hundred thousand years, but only within the last two decades has he heard about organized industrial research. It is therefore fair to say that relatively little is known about the best way of doing it. It is a started experiment, and perhaps people will decide sometime that the present course is a terribly dangerous race

for merely material things and so must be changed. We may sometime settle back in static and dynamic equilibrium, each one busied with his neighbor's laundry. But before this is done, we here expect that competent research men will in general receive pecuniary rewards approaching those of men who merely "sell the stuff." There is a healthy tendency in that direction. However, this talk is not an appeal to the public for higher salaries, but rather an attempt among ourselves for better understanding of what constitutes encouragement.

Industrial research is an expression of the advanced and advancing state of American minds. This is true not only of the industries but also of the research men themselves. Nothing seems established except this forward movement. It is what Kettering, of General Motors, might call a "perfectly satisfactory unsatisfied, but not dissatisfied state."

The obvious way to encourage is by encouragement, but encouragement has never been standardized. Coin is a token and performs useful functions, and salaries of research men will continue to rise. The accumulated research of an inventor's lifetime used to be sold for what it would bring under a forced sale. Novel processes and new ideas were produced by millions (there are nearly two million American patents), but not one per cent. of the hard-working inventors were ever rewarded at all. They worked under heartbreaking disadvantages and carried the entire risk of their ventures. The public would have been well justified in sharing the risk with competent workers. Later it seemed more promising to grubstake the inventor, and this was quite generally done. Many lines of industry were built about a single experimenter. The more recent scheme is to stake groups of trained and selected investigators and combine their work so that new results may be continuous. This is now a tested development. It is easy to see its advantages. On the whole, it costs the public less and produces better results than the shiftless way of rewarding the occasional inventor who ripened his product on the day the market was exactly ready, while declining even to feed the poor fellow who was far-seeing and got ahead of the procession.

But the unlimited use of coin alone does not guarantee satisfaction anywhere, and we are thus led from the subject of salary, in which no one is expert, to the conclusion that the adequate compensation for encouragement to continue research must include those tokens of appreciation which other creative people generally desire. This is a strong survival principle for a race. Publication in some form to bring recognition by one's peers is the nearest equivalent to the artistic painting, the beautiful poem, the enduring sculpture and the splendid architecture of other creators. The most altruistic and far-seeing leaders realize the importance of this encouragement, and even those who have never analyzed it instinctively feel its value.

Another token of research appreciation, strange as it may seem, is further opportunity for more and better work. The research man must progress. In the industry this means improved facilities, new apparatus and enlarged activity of all kinds. Every good research man wants to work with new and improved tools, and this includes everything, from freedom from interruption to added assistants and floor space. If this encouragement is criticized as not being a token of appreciation, I can only say that it is a weighty matter of experience.

WILLIS R. WHITNEY
RESEARCH LABORATORIES,
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IS RESEARCH A GAMBLE?

RESEARCH is good business when run on a business basis. Scientific study of an industry from every angle will pay for itself in the new knowledge gained. If new products or new processes come out of such research, then is the time when one may expect to begin to spend money. The development that must follow research if successful production is to come later may cost many times as much as the original research, with a chance that all may be lost. A good research business man takes no blind "fliers," but first feels his way, making his mistakes on a small scale rather than later on a large, manufacturing scale. Thus is the chance for failure reduced to a minimum, provided resources are not exhausted by too large a venture or too many new development projects at one time. Industry must engage in research or fall behind in the race to-day. Intelligent, persistent research and development is bound to win in the long run. If all is not staked on one idea and a few experiments, the law of averages will remove most of the gamble. The successes may not be along the lines of first endeavor; they may be even greater than at first thought possible; but they must at least earn enough over the returns from standardized, competitive industry to warrant the risks and the expensive delays incident to all industrial development.

L. V. REDMAN

RESEARCH IN THE ENGINEERING COLLEGES[1]

THERE are significant differences of national policy concerning the character of the higher schools of engineering and their function in the social order

[1] Read before the Section of Engineering, American Association for the Advancement of Science, New York, December 29, 1928.