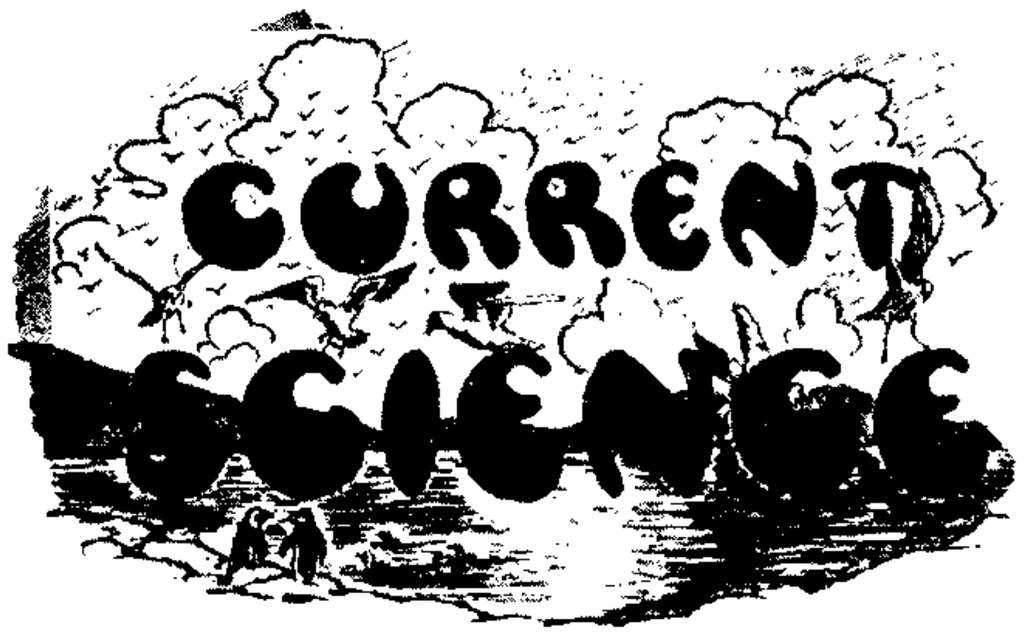

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Science and Industry.

IT is not generally realised, even by promoters of Industry, that Science and Industry are no more closely related to each other than Philosophy and Religion. It is indeed true that Science provides the basic material for the development of Industries: it should also be admitted that no industry can prosper unless scientific methods are adopted. On the other hand, Science plays only a small part in the organisation of industry. The scientist is only an humble unit in the machinery that is engaged on the conversion of a cheap raw material into a valuable finished product which the consumer buys. The work of the scientist constitutes the foundation on which the industry is built and which, in consequence, should be safely and securely laid. It does not, all the same, constitute the entire structure. The scientific worker is fitted to lay more foundations and even strengthen the existing basis, but the main structure must be built by others. It would be of much assistance, therefore, to the progress of industry if the significance of the above could be realised by all concerned, so that there need be no delusions regarding the rôle of the scientist in industrial organisations; so that his talent may be more usefully employed in the conduct of fundamental researches leading to new industries or in solving technical difficulties relating to the existing ones rather than be diverted into lines of work for which he is not fitted and wherein he may prove a failure.

The truth of this position is, no doubt, realised by the more progressive industrialists, who collect together the right types of talent and organise them into a homogeneous machinery that constitute the prosperous industry. On the other hand, it is not appreciated by many others, particularly in India where the management content themselves with finding the necessary funds and leaving it to their scientific staff to become also the manufacturers, advertisers and even salesmen! The result is that the scientist is obliged to neglect or put off his legitimate duties. He is not generally fitted by either temperament or training for the different types of operations that he is called on to undertake so that, more often than not, he fails in such ventures. Ultimately the industrial venture also proves a failure and the poor scientist comes in for general censure.

A critical inquiry into the failure of a number of industrial concerns both in India and abroad would reveal that most of them are due to faulty organisation. There is no doubt that certain important factors like the cost of raw materials, efficiency of the processes involved, demands of the market, external competition and the nature and extent of State assistance that largely determine the success or otherwise of any industrial venture, but being given favourable conditions, the prosperity of a concern depends almost exclusively on its efficient organisation. The right type of talent for each particular operation should be found and then fitted into the right place. It is the efficiency of this process that determines the ultimate success of an industrial venture.

It is, perhaps, no exaggeration to state that some of the biggest industrial organisations of the World, like several other great ventures, are essentially the creations of single brains. It is that master-mind which first conceives of the venture, selects the right kind of staff and co-ordinates their work into a homogeneous organisation. Such were Ludwig Mond in England, Alfred Nobel in Sweden, Andrew Carnegie in the United States and Jamsetjee Tata in India. Industrial geniuses of that type are, however, very rare. More often than not the business is managed by small groups of men, sometimes not more than two or three, who understand each other perfectly, who make up for each other's shortcomings and work as a unified body. A management of that type would also possess the requisite vision, the right type of scientific as well as business outlook, necessary skill in the choice of staff and the co-operation of their workers. The success of many of the present-day ventures depends on the efficiency of the combination that constitutes the management.

Now the question arises as to whether the management should consist of business men with the necessary scientific outlook or whether it should also include scientists. A scrutiny of the compositions of the administrative councils of the more progressive industrial concerns in different parts of the world would show that most of them include representatives of the branches of science relating to the industries concerned. Unfortunately, such is not the case in India. More often than not, the management consists of business men—clever, cool-headed in their own ways—but sadly lacking in scientific outlook, with the result that they are out of tune with their works and research staff at whose tender mercies they are often placed for the progress of their venture. The result is that the technical staff determine the policy of their heads and assume more powers and responsibilities than they could do justice to, with the result that the major issues of production and distribution are obscured and the venture proves to be far less successful than it could otherwise be. Sometimes the reverse also happens. The management—non-scientific in outlook—starts with an aggressive hand, with scant courtesy for the opinion of their technical staff, so that the latter is compelled to bow down to their ideas—often unworkable—so that the venture loses in efficiency and ultimately proves a failure. It would be seen from the above, therefore, that the combination of the scientific and the business outlook is essential to the success of any industrial organisation. Where the business men lack the necessary scientific outlook, the proper procedure for them will be to choose scientific men in whom they have some confidence and plan out things in conjunction with them before launching out on their ventures. The representation of scientific interests in the management ensures a certain amount of sympathy and friendliness for the technical staff, as also appreciation of the difficulties involved in the various operations which go to make the industry. No industrial venture will prove successful unless there is proper understanding and close co-operation between the management and the technical staff, and sooner this is realised by those interested in industries, the better it will be for their ventures.

In recent years, several industrial concerns, particularly in India, have proved unsuccessful chiefly because of the over-lapping of the purely scientific and the 'works' staff engaged on the manufacture. It would be of much assistance, therefore, to critically examine the parts played by the two groups of workers in a well-organised factory. The research scientist provides, no doubt, the basic material for the venture. He conducts the necessary preliminary trials—all on small scale—standardises the conditions for the different operations and then passes on the details to the works staff who follow up the idea on commercial scale. It is very rare, however, that the operations lend themselves straightaway to development on bigger scale. More often than not some of the steps which

prove easy in the laboratory turn out to be highly difficult on factory scale or prove too costly to be commercially successful. Some of the difficulties can be overcome by the works staff themselves who can modify the technique to suit their requirements, but cases often arise when the problems will again have to be referred to the scientific staff who will have to devise new methods of managing the operation more efficiently. In this manner there is frequent swing of technical researches between the laboratory and the factory until all the related processes are carried out to perfection. Even then the scientific staff will have to go on with their work, trying cheaper raw materials, alternative methods of manufacture or otherwise go on improving on the process so that the cost of production may be brought down to the lowest possible limit and products of the best quality can be made available at very small cost to the public. It is only then that the process will be in a position to hold the commercial field and face continuous external competition successfully. In India, on the other hand, the purely scientific work of the laboratory is made to overlap with the large-scale operation in the factory, the same staff being employed for both the purposes. In a few places there is some distinction, but it is only in name because the qualifications and the experience of both the groups of workers are of the same order so that the result is, more often than not, highly unsatisfactory.

The above defect is partly due to want of sufficient knowledge of the respective positions of the two groups of operations in an industrial organisation and partly to dearth of the right type of talent, particularly for the management of large-scale operations. There are still several industrialists who are slow to realise that the pure scientist, while being eminently suitable for the laboratory work, is not really qualified for the factory operations. In fact, it will be a waste of talent to divert the research scientist from the laboratory where he can do useful fundamental work to the factory. The managements of many industries are not, however, sufficiently alive to the significance of this weak point in their organisation and make the mistake of trying to save money by employing the same persons to look after both the laboratory research and the commercial operations. The result has rarely ever been satisfactory.

The question naturally arises as to what types of talent are required for the two main groups of technical operations in the industry—scientific research on the one hand and factory production on the other. We will first consider the requisite qualifications of the research scientist, because his work constitutes the basis of the industry. He must naturally be an expert in the related branch of science and possess the necessary imagination to determine how the scientific work should be directed so as to yield the final product at minimum cost. He must have an idea of the prices of the materials he works with, so that he may avoid the use of the more expensive ones if others, equally efficient, can be obtained at lower cost. He must be quick and energetic and be alive to the fact that the rapid solution of the basic principles determines either a successful patent or some quick advantage over other rivals in the field. The industry and skill of the research scientist may often make all the difference between large profits on the one hand and heavy losses on the other. The scientist must also have some idea of the difficulties involved in the translation of his processes into large-scale operations. His methods should also be so planned as to suit, as far as possible, the available equipment in the factory. He need not be an engineer but he must have some idea of the possibilities of the available machinery before advising his factory colleagues to carry out his plan of operations. By so doing, an expert research scientist would eliminate many of the difficulties to be encountered in the factory or, at any rate, so minimise them that the technical process soon becomes an accomplished success. The type of talent required for the purely scientific work in a factory is now being turned out by most Universities and Research Institutions in different parts of the world. It may not be very difficult, therefore, to choose the right type of men for conducting the purely scientific work leading to the organisation of Industries.

The choice of the works staff, on the other hand, is very much more difficult, the chief reason being that the right type of talent is not available. Taking the chemical profession for instance, there are, perhaps, a few thousands in India alone who possess the requisite scientific knowledge but there are very few among them who have had the necessary works experience for conducting operations on commercial scale. The fault is not entirely that of the scientist. It is no

doubt true that many of them do not have either the interest or the inclination for the type of work that a factory demands, but there are also several others who, in spite of their keenness to learn, do not get the opportunity for the right kind of training. Although hundreds of scholars have gone abroad in recent years either at their own expense or that of the State, for training in industries, only a few of them possess the requisite experience for initiating such industries. Most of them would, in fact, appear to have diverted their interests to purely laboratory work partly because the factories were more or less closed to them and partly because there still persists, in every part of the world and particularly in India, much glamour for higher degrees which are much more easily obtained through the laboratory than through the factory. It is this defect in the technical training of the staff, as also want of proper scientific outlook on the part of the management, that have been largely responsible for the non-expansion of several of the existing industries in the country or the failure of many of those that were started during recent years. These defects must be remedied at once for, otherwise, it would be very hard to envisage any useful industrial development in the country.

The question which naturally arises is, how is the condition to be improved? The factories in other countries would naturally close their doors to their would-be rivals. It is very doubtful if even the few factories now working in the country would be prepared to provide training that will lead to the development of similar industries elsewhere. It becomes necessary, therefore, that training in factory operations should be provided in public institutions specially equipped for the purpose. A move in that direction is already in progress in some parts of the country and it is not unlikely that the different technological institutes will soon turn out competent men who could carry out the factory operations relating to different industries.

In modern times, with numerous rival organisations and hard struggle for existence, no industrial venture will be successful without the aid of adequate advertisement and sales agencies. It is not within the purview of this contribution to consider the organisation of these two important lines of activity, but it should be emphasised that they are outside the scope of the scientist, who should not be asked to shoulder them.

Now what is to be the organisation for the development of new industries? It is a vast subject by itself: so we will confine our present remarks to those that relate to the scientist in the factory. It is often suggested that the scientist should come forth with the ideas and methods and get the business man interested in the possibilities of the venture. Some would even go further and suggest that the scientific man should also work out the costs, and demonstrate the working of the factory on a small scale; that he must also study the demands of the market and undertake the disposal of the product. There are probably a few men and women in the world who can manage all the above-mentioned operations successfully, but the majority cannot hope to do justice to more than one each. In the more progressive countries, the idea of a possible industry first originates in the mind of the man with some money and the necessary liberal scientific outlook. He then studies the possibilities of a venture, investigates the trade returns in the particular industry and, if the conditions prove encouraging, he proceeds farther to discuss the possibilities with the scientist, who is an expert in the particular branch and the engineer with the requisite works experience. He then provides funds and facilitates for systematic scientific work either in a place attached to his factory or in a research institution where the operations could be carried out on a small scale. If the preliminary researches prove encouraging, the process is then tried on semi-commercial scale at a place where the required equipment could be had. If this also proves successful, the process is then transferred to the factory where the operation could be carried out on the necessary large scale. The other sections of the organisation will then naturally follow.

It would be seen from the above that although the scientist plays a very important part in the development of industries, there is yet much in the organisation for which other types of talent are required. The future development of industries in the country depends, to no small extent, on the right type of organisation and if this contribution has brought home a few fundamental facts relating to it, then our efforts would not have been in vain.