

to the process of manufacture declined, and the trade for many of the delicate shades of dyes passed altogether into the hands of the Germans. Even now those who are prepared to employ chemists to spend their time in experimenting to discover new processes hesitate to act because they fear that their efforts may not be properly safeguarded. Such things show how inter-dependent we are: each class can do little without the other, and labor may well be included in the chain of progress, for labor is a link equally necessary with the others. There is a danger, of course, when different classes come together, that they will not work harmoniously, and it would be strange if they did. Masters and men are looked upon as antagonistic at the present day because their interests are antagonistic, but it is in no way necessary that, because the interests of the master and the worker are unlike, therefore the master and the worker must be antagonistic to each other. I shall refer to this again later on.

A greater widening of our horizon is necessary, and a greater willingness to collaborate with the scientist and the experimenter. We, as engineers, have not shown ourselves to be quite free from blame in this direction. We have been prepared to accept into practical service inventions after their success has been proved by others, but devices from which great economy could be secured are frequently looked upon by us as fancy accessories, upon which a practical man has little time to spend.

It is not pleasant to acknowledge that we can learn from our enemies, but in the attention which is given by Germany to science and experiments with a view to the discoveries proving of national value, there is a lesson worth learning. I would not say, however, that the acquiring of German methods and German systems are the be all and end all. We can see in their economic suc-

cesses the results of training which their schools supply, but it must have occurred to many whether or not the successes in themselves are a sufficient warrant for the cast-iron system which is so typical of German practice. Is such a system responsible for the lamentable want of sympathy and understanding of the feeling and course of thoughts of others, and does their lack of appreciation of the moral practice of civilised communities spring from this cause? A slavish copying of their systems, such a copying as I shall refer to presently, might bring along with it undesirable results, and might rob us of those great qualities, power of initiative and of resource, which have been our salvation. It would be a poor exchange to give away these qualities for science made perfect by system, which might easily change into system made perfect by science. Information on practically any subject may be presented in systematic form for the absorption of students, but accurate observation and reasoning form a much preferable method of securing a lasting and a useful knowledge.

Professor Barraclough, in his address, referred at some length to the Trade Schools and Technical Colleges, and the opportunities which are, and which should be, available to our young engineers for training them to take their proper place in business life, and if our Empire is to maintain our commanding position in the world of engineering and commerce, we, as part of the Dominions, must, by scientific training and education, fit our sons to play their parts in the coming struggle for supremacy. The struggle will be keen, and victory will rest with those who not only have knowledge, but who know how to apply it to advantage.

The next section of my address, then, will apply more especially to our junior members, and, while Professor Barraclough indicated the systems of training, my re-

marks will be addressed more to men as men of the business world. This section will not apply quite so much to the senior members of our Association, but as our Association covers not only members and associate members, but also students, I think that it is not out of place to devote a portion of the presidential address to them. Upon our young men will fall the chief burden in the coming struggle for supremacy in the arts of peace, and an indication of how they may equip themselves to the best advantage amounts at least to taking the horse to the water. I am going to take it as an axiom that every young man desires success. Success is defined as the touch-stone of life. It is a subject in which everyone is interested. It is something of which we all wish to partake, yet we allow the element of chance to play the leading hand just at the most important period of life, that is to say, when a young man is preparing himself for his future occupation. It has frequently seemed to me that it is only by accident that the world gets the best that a man has to give it, and this is largely owing to the fact that in this country he is not properly directed during his years of training. Many of us drift up into our life's duties and are surprised to find how different is our life's work from what we at first anticipated: looking back we can see where we could have benefited by the warning or by the suggestion of those who know where and why they had themselves made mistakes, or had omitted to take advantage of opportunities; but because of the want of close association the advice was not offered, although perhaps it would have been willingly given if the chance to do so had presented itself. It is right that a man should fight his way up in the world, but this is no reason why we, who have had experience, should not be ready, and make it our duty, to consider how we can assist our coming engineers with advice as

to the best course in which to direct their efforts. We do not expect a young engineer to evolve and design every detail of an engine; what has been done by those who have worked and practiced before him is available for his use, yet in our general system of education we leave him to become acquainted with many of the vital factors which affect his after life.

I wish to refer here to some of these vital factors. A man must have ambition, not merely to know things, but to have the power to apply this knowledge. There is a talent of originality in every man to some extent, a power of applying his mind to think for itself, but there is issued with this power the condition that it must be constantly cultivated or it will languish and will eventually become comatose. A slavish copying of others, their ideas or their work, quickly results in the mind refusing to act with vigor, and it becomes incapable of working without a pattern to work from. And there is the converse that if the brain is trained to be self-reliant, and to preserve its own individuality, it will resent the idea of being bound by any convention. We seldom grasp to the full the meanings of our own thoughts, because we do not stop to consider them fully. Occasionally we recognise in a book an idea which we had previously looked upon as entirely our own. Perhaps the idea, in its original form, was crude, but it was there; it presented itself to us, and we thus had the opportunity of developing the idea if we had trouble to do so, but the opportunity being neglected, the credit of originating the thought passed to another. The mind must be kept trained and active to recognise useful inspiration. The reading of a book on a technical subject is of little value if we only read and perhaps understand, but do not remember what we read; the utmost benefit can only be secured by placing ourselves in full sympathy with the

writer and by tracing the reason for his statements. Moreover, because an author writes a book or an article in a journal, it does not follow that what is written be accepted without question and without challenge. That one may be capable to forming sound judgment of a theory, he must intelligently understand the reasoning upon which the theory is based. What I wish to impress is the necessity of guarding against becoming merely a receptacle for knowledge without digesting the knowledge. Book information is not to be taken as merely something to be committed to memory as useful knowledge. To do so is not going far enough. There is in such case the danger of making the mind a mechanical apparatus which may, if the mechanism does not break down, travel through life, and perhaps successfully. but it will be on the shoulders of others. I would advise our young men to try and be original if it is only in endeavouring to find out why things are as they are, and why things are done as they are. The mental powers will then be kept active, and will be more likely to strike out on new and original lines than if the brain is used as something to be stored with knowledge which others have discovered. What others have done should be used as a means to an end, and only so; it is better to be able to ask intelligent questions than to know the calculus.

The professional man, consulting engineer, and the working man, too, has a store of wealth when he has mastered his tools, of whatever shape they may be. I can think of no happier condition in which a man may be placed than that he should know his business thoroughly, and know that he knows it. Such a man has no need to copy the work of others, though he may have studied it; he has made his profession, and what is connected with it, his life's associate, and he has a confidence in himself which is the key to success. Compared with the man

who has merely poured knowledge into his system without exercising his mind in the receiving of it, the first has assimilated his knowledge and can apply it, while the other has his knowledge available so long as his memory holds good, and only so. The first, the thinker, is likely to be the leader, and it is his opinion which will be listened to with the greater respect. The mind is there upon which to build; this is the skeleton; the system of instruction provides the muscles and sinews, but inspiration is necessary to complete the work, the knowing how to use the members which make up the body, just as, in the allegory of the Creation, God breathed into the man, made of clay, and he became a living being.

I say, then, get knowledge—more knowledge—but preserve your initiative. Think out the reason of things—all energy is born of thought—practice originality. Be always thinking. Do not run away with the idea that the best and most useful inventions have already been made. Possibly we have thought that those who came before us picked from the tree of invention the fruit which was easiest to reach; but it was just as difficult for them to reach the lower branches of this tree as it is for us to climb to the higher branches with the means by which they have provided for us to climb with, and the best fruit is often at the top of the tree. It required just as much brain power to develop the steam engine at the close to the 18th century as to develop the dynamo at the end of the 19th century.

With regard to what I have said as to keeping the mind open for originality and initiative, it is equally important to study what others have done, not only their successes, but their failures, and the failures are frequently more instructive than the successes. I know of numbers of technical books which describe complete installations of plant of various kinds, but I cannot re-

member many which gave a history of the unexpected troubles encountered in the course of the work of construction. They show too much what should be done, and too little of the dangers which are always waiting to waylay and pounce on the innocent. From what is described in a number of books, it might be inferred that everything is straightforward, but let an engineer not acquainted with practice read a description of a coke conveyor, and then build one to work under rather different conditions, and he will find there is a great deal more knowledge wanted than just to know how to make the machine go round.

Professor Barraclough last year referred to the pathos of a scrap heap, but the scrap heap has its uses beyond being a dumping ground for out-of-date or broken material. The study of the scrap heap will show, perhaps more than anything else, where things break, and where weakness of design has crept in, and until these points are fully appreciated no one is properly qualified to design machinery; and further, such a study may prove the means of avoiding faulty designs which would have proved expensive were it not for the revelations which the scrap heap has given.

Engineering depends largely upon commerce, and commerce is by no means to be despised by the young engineer learning his business. As he advances in life, and as he assumes more important positions, he will find that business matters begin to call for more of his attention than technical detail. So much is this so that his ultimate success will depend more on his business ability than on his knowledge of text books, and it is right that such a man should prepare himself in good time to be able to take charge of the business and financial end of his profession, and not neglect this while he is giving his attention to the study of technical know-

ledge; the man who possesses the combined information will invariably take the lead. It is not necessary that every business man should be an engineer, but it is very advisable that every engineer should be a man of business. There are various opinions as to what constitutes a man of business, but I think it is well covered by the following, which I have taken from a recent issue of the "Times' " Trade Supplement:—"One who has himself purchased raw material, learned how to turn it into manufactured articles, and been brought into close contact with labor for a long period while the material was in process of manufacture. He must have interviewed customers and obtained orders in competition with other men of initiative. He must have experience in bookkeeping and invoicing, in the transport of goods by rail and sea; he must know the procedure for passing goods through the Customs House, and must understand the business of Bills of Exchange. He must know how to finance his own business when money is tight, bringing into play, day after day, the resources of his own personality. He must have the enterprise to grasp opportunities, make quick decisions, gauge the value of new things. He must be accustomed and willing to act in a crisis on his own responsibility."

You will, perhaps, say that the range is altogether too wide, and that no man can attend to his engineering business and at the same time be expert in each one of the above qualifications, but I venture to say that there is no leading engineer of the present day who will not agree that each one of them is desirable, and who would not gladly know that he is an expert in all.

There is still another matter in connection with this portion of my address. The young engineer must study men with whom his business will bring him into contact. He will meet men of various dispositions, and he must



train himself not only to become efficient in the handling of labor, but also so that he may bear himself with confidence when brought into contact with other business men. The power of imparting confidence in others is only possessed by those who have confidence in themselves, and self-confidence will never be won by a too deferential retirement from public notice and by an unwillingness to express one's opinions in public.

Professor Barraclough drew attention in his address to the low relative remuneration given to engineers when compared to the other professions, but is not the cause of this that the engineer confines himself too much to the technical side of his business and neglects the commercial side? Is it not often frequently said by an engineer that his profession is that of an engineer, and he does not pretend business or commerce? Such a statement is an indication that he is willing to be used as an instrument only by the man of business just as a machine tool is operated for the purpose of getting a certain amount of work out of it. If our young engineers will study how to make themselves men of business as well as expert engineers, not waiting until life's duties force them into taking up duties for which they have not trained themselves, I believe that the status of the profession will be greatly improved, and there would be less complaint of poor remuneration.

You will perhaps think that I have wandered far from the subject which I originally set out to talk about, namely, the application of science to industry. I have not done so really, for I consider that it lies with an Association such as this to see that those who follow after us shall at least be told how they should prepare themselves to meet the altered and more strenuous conditions which will soon obtain, and it is well that they should

study how co-related are science and industry, and with them will eventually lie the problem of evolving practical systems for the collaboration of science and industry.

Now, with regard to the disturbances caused by industrial strikes, the second of the outstanding features I referred to at the outset. Our own State of N.S.W. possesses a most unenviable reputation in this connection. Figures published by the Commonwealth Statistician show that in 1915 more than twice as many working days were lost in N.S.W. through industrial disputes than were lost in all the other States of the Commonwealth, and more than five times as much money was lost to the workers in wages. We have become so accustomed to strikes that we hardly give enough serious consideration to the extent in which they are affecting the productivity, and hence the wealth, of the country. If a worker does a fair day's work for the wages which he receives, the work which he has done should be of at least equal value to the country as an asset. In other words, the community, considered as a body of employers, would be willing to pay the amount of the wages in order to have the work done, and the money paid as wages by the community is for the maintenance of the worker. If, then, the worker has to be maintained and kept by the country, and his work is not done, the country is the poorer by the amount which it has cost to maintain the worker while he is idle. Let me try and put it to you more graphically how great is the tax on us from this cause. The loss of wages for 1915, due to strikes in New South Wales, is given by the Commonwealth Statistician as £292,276. This is just as though the country were to employ a man and keep him usefully employed for nearly 2000 years of working days, and pay him wages for all that period, and at the end of it were to set to work and obliterate everything he had done. There would thus be left the position that the man had been kept for 2000 years as a parasite on the commu-