

Technical ability and scientific knowledge are not written first because it is thought to be of little importance, but because ultimately the other principles being broader have a bigger bearing on the resultant man.

A man may be a great engineer with only sufficient scientific knowledge to eliminate the impossible and whose sole characteristics are his imagination, ingenuity, and experience, but who possesses a mind capable of conceiving or forecasting and in rare instances defining the desirable and necessary (as the case may be) in the human economy. Such was the elder De Lesseps, James J. Hill, Harriman, Carnegie and a host of others among the pioneers in industry on this continent.

Imagination is to be interpreted as broad vision, creative ability. Technical ability considers scientific knowledge applied in the light of experience, reason and common sense. Efficiency is generally defined as the ratio of the work expanded to that produced and in a larger sense is the process of effectively correlating all of the operating forces and energies in one unit for economical production. Executive ability is the process of successfully commandeering and utilizing the services of others.

The provinces of engineering and economy are often intertwined to such an extent that it cannot be said distinctly just where one ends or the other begins. Engineering which is not economical is not good engineering, and economy which will not bear rigid scientific investigation or treatment, such as an engineer would subject it to, is not economy.

Where we attempt a rigid mathematical analysis in any instance, we must be sure of the premises, and it should be remembered that scientific analysis does not necessarily mean mathematical precision to the exclusion of the broader judgment based on experience and common sense.

An engineer's education after it reaches a certain stage should be along broad lines, to include the humanities, so as to fit him for leadership.

A knowledge of men which the old school believes can only be had by contact, but which some now seem to think can be obtained through the mastery of what has been called the Science of Character Analysis of Dr. Blackford, is more to be desired than a knowledge of integral calculus and by all odds gives one a better chance in life.

Many engineers are of necessity employed by industrial and commercial organizations. Some are born to lead and others to serve—in whatever class we find ourselves it is up to us to do our utmost. To be able to intelligently and successfully carry out orders is a faculty not to be dispised and, by the way, it is not the easiest task imaginable.

An engineer's actions should be guided solely by the Golden Rule, and equity, not policy; that is, strict justice, rather than law, should govern. In his relations with the contractor he occupies a sort of judicial position, and must possess great discriminating powers and must appreciate point of view.

It is better to be right and to act justly, even if appearances are against you, than to be guilty of a wrong, even with appearances in your favor.

In his relation to his employers it goes without saying that they are the sole judges as to his ability and fitness. In his dealings with them he must possess candor and ability to look out for their interests without sacrificing his own. It is a fact that is not to be disputed that he must be true to himself, first, and that he must not forget or overlook his own interests.

To become so absorbed in your work as to be oblivious to one's own interests is not demanded by any of the precepts or the examples that we have of the greatest of our professional brethren, and it can rightfully be said that disloyalty is a crime, whether to one's self or to one's employers or clients.

In every instance the contractor should receive a square deal at the hands of the engineer and in no instance should the engineer have it in his mind to get square with the contractor for some fancied or even real act of omission or commission. Those who have had sufficiently broad experience recognize that specifications are intended to be interpreted in the spirit, rather than in the letter. As Theodore Cooper, in his day recognized as the foremost bridge engineer in this country, put it, "The best system of rules to insure success must be interpreted on the broad grounds of professional intelligence and common sense."

Constant bickering, indicating lack of poise and persistent petty fault-finding without being able to offer suggestions for the betterments of conditions, is the method pursued by many young engineers to the detriment of the work on which they are engaged.

There is absolutely no reason why the most cordial relations should not exist between the contractors and engineers engaged on the same work and there are probably the very best of reasons why they should, as their interests are alike.

The specifications are often the rock on which the cordial relations of the engineer and the contractor are rent asunder.

Contractors, like engineers, are actuated by the same motives as other men. The engineer may or may not be superior to the contractor, but he cannot show his superiority by taking undue advantage of him.

Contracting, according to the usual methods in vogue, of which some one has aptly said, "The profits are limited by competition, but the losses may be unlimited," should no longer prevail, but as it is or should be a legitimate business, the gambling element should be removed therefrom, and should certainly not exist to a greater extent than it exists in any other ordinary business.

Contractors would be better men as well as better contractors if their remunerations were fixed, rather than problematical, as is usual.

The party for whom the work is being done should take all of the incumbent risks, and then any incentive of the contractor to take advantage is removed.

Some specifications deliberately give the engineer the whiphand, but it has been determined in the courts of this country that it cannot be employed without considerable danger. As engineers, we know that the action and reaction are equal.

Clauses which have a double meaning or which can be interpreted in two ways should not be written in specifications. A contract represents a meeting of the minds of the contracting parties. The engineer should not attempt to protect himself by inserting obscure clauses in specifications whereby he may cover up his own ignorance or shortcomings at the expense of the contractor.

Copying clauses from one specification into another without fully understanding their meaning, simply because they are time-honored, *i.e.*, because custom has sanctioned them, which is not unusual, is a very silly and at the same time dangerous practice.

Few men have ever been vested with considerable power who haven't at times abused it, and the engineer who prepares the specifications and who interprets them