## VALUE OF A TRAINING IN THE HUMANITIES FOR ENGINEERS.*

By Nelson P. Lewis.

WHILE there are some conspicuous instances of engineers who have achieved marked success without the advantage of a degree from a technical school, the large majority of practicing engineers have had the benefit of a technical course before beginning their professional careers. In order to make any intelligent suggestions as to the subjects which should be included in such a course of study, it would be well to consider briefly the kind of work the engineer will be called upon to do. Engineering was formerly believed by the average citizen to be little more than a trade. It was thought that an engineer should be able to use surveying instruments and be able to compute land areas and the volume of a cut or fill or of a mass of masonry. He might be able to build a road, but in this respect he was held to differ very little from the average citizen, who appears to have been born with the conviction that he is as competent to build a road as to serve in Congress. The engineer's function was conceived to be the planning and carrying out of what others may have concluded to be necessary and expedient. Those who determined what was to be done seem to have felt it to be the duty of the engineer to do things when he was told, as he was told and because he was told. For a long time the engineer himself appeared to acquiesce in this conception of his functions. Whether or not a certain project was feasible or timely, whether the type of structure or the material which it was proposed to use was best adapted to the purpose, whether the enterprise would justify itself on economic grounds, whether the plan of financing it was sane and prudent, whether the terms of the franchise or concession, if such were involved, would insure adequate protection for the public and at the same time permit a fair return on the capital investment—such questions were not his concern. They would be settled by attorneys, capitalists or the public authorities. The engineer himself was not inclined to assume any responsibility for them; it was his duty to see that the general plans were honestly and expeditiously carried out. While he realized his responsibility for the stability of any structure erected under his direction he had little concern for anything but its physical stability, although he desired assurance that the funds were available to cover his fees or salary.

These were the conditions which prevailed within the memory of most of us, but they do not exist at the present time, except possibly in some branches of the public service, municipal, county, state and even federal. No financial concern engaged in floating bonds for private enterprises will now undertake to handle such securities until they have had a report from competent engineers as to the soundness of the project, including not only its engineering feasibility but its probable earning capacity and the market for its output, whether that be power, light or any manufactured product. Such reports, if they are to carry conviction, must not only be technically sound, but they must be orderly in arrangement, clear and concise in the presentation of facts, arguments and conclusions, and must bear upon their face evidence of the absolute confidence of the writer in the accuracy of his facts and deductions. Further than this, the engineer must frequently present verbal explanations and arguments to the promoters or to a board of directors before the enterprise is undertaken as well as during its progress, if he is charged with its execution. Many reports resulting from thorough and painstaking investigation fail of their purpose because the subject matter is not presented in an orderly manner and the conclusions are not clearly and concisely expressed. Often, too, when the engineer is called before a board of directors and asked for further information the impression which he makes is an unfavorable one, due, chiefly, to the use of poor English and the self-consciousness which comes from lack of practice in speaking.

The head of a large industrial corporation, who was also the chairman of a board of trustees of an engineering school and was urging the broadening of engineering education, put the case in this way:

"We can get plenty of men who are technically competent, who are careful and thorough in their investigations, whose conclusions we know to be sound, but who cannot make a favorable impression before a board of directors. We can get plenty of lawyers, who, after being coached by our engineers, can glibly and even convincingly talk to this same board of directors until some question is asked which has not been covered in the process of coaching, when they, too, will flounder about. If we can secure a man who possesses the conscientious thoroughness and accuracy of the engineer and also has the facility of expression and persuasiveness of the lawyer, what is a salary of $25,900 or $30,000 to us for such a man?"

He, therefore, urged that this particular school, instead of trying to turn out a large number of $2,000 to $5,000 men, give to the profession a limited number of $25,000 to $30,000 men.

What kind of studies are best calculated to fit a man for such a professional career? Let us say that the purpose of his training should be to insure:

(*a*) Honesty and accuracy in his reasoning.

(*b*) The habit of thoroughly testing his conclusions in order that they may be not only the logical, but the inevitable, result of his premises.

(*c*) Clearness and simplicity in his presentation of both premises and conclusion.

(*d*) Orderly and logical arrangement of both, so that they may readily be followed by those to whom they are addressed.

Personal honesty and high professional ideals are, of course, essential to true success in any occupation, but the course of training in these subjects should begin before a boy is born and we are considering only his professional training after the high school period.

The study of mathematics should induce accuracy in thought and work. An error cannot be tolerated and will inevitably be discovered in the solution of a mathematical problem which, if properly checked, will prove itself. If not so checked and its accuracy proven, the perpetrator of a mistake cannot escape its consequences. Such reasoning, however, is conducted through the medium of formulæ and equations which are not understood by the layman for whose benefit they must be converted into ordinary language. If we are to insist, as it will doubtless be admitted that we should, that engineering is one of the learned professions, ranking in dignity with law, medicine and theology, we may also insist upon the desirability of an equally thorough foundation upon which engineering training is to be based. It will be futile to urge that en-

*Paper presented before Section D, Engineering, of the American Association for the Advancement of Science, New York, N.Y., December 28, 1916.