

and manufacturing enterprises in this country. The Engineering-Schools of the University of Pennsylvania already stand high; but it seems to me that the opportunity lies open to them even more than to their famous medical and law schools to stand at the very top. This magnificent building, equipped as it is with the latest and best of everything, is the first and a great step towards this end. But, after all, your largest possibility and one which does not exist for, and can not be created by, any other American university, lies in the opportunity for bringing your students into close touch and personal contact with the men who are working in and managing the great industrial establishments of Philadelphia.

FREDERICK W. TAYLOR.

*THE ENGINEER AS A CITIZEN.*

I CONSIDER it no small honor to be included as one of the participants in to-day's program. But though I come on the invitation of those in authority, I hesitate to appear before this audience, gathered in sympathy with so notable a step in the development of one of the greatest of America's universities, a university presided over by a man eminent as an educator, an administrator, and a man of affairs, to express my opinions on questions of engineering education and citizenship and their correlation.

In spite of apprehensions as to my insufficiency for the duty I have accepted, I shall make no apology, but fall back upon the fact that, having been called to serve the university to which as an adopted son I proudly owe allegiance, it remained for me but to obey. I can only promise you that I shall not vaguely theorize, but I shall speak from my personal experiences in the fields of business, engineering and education.

In coming before you as the president of

Stevens Institute of Technology, I come as the successor of your own Henry Morton, a graduate of, and later a professor in, your university, secretary of the Franklin Institute, professor in the Philadelphia Dental College, brilliant lecturer, profound scientist, man of affairs, but above all a simple-minded seeker after the truth, too modest to recognize his own great qualities of mind, qualities combining the grasp of genius with the sanity of common sense.

It is peculiarly appropriate that the University of Pennsylvania should develop a thoroughly efficient department of engineering education in view of the important scientific work done by the many-sided Franklin, upon whose suggestion the original Philadelphia Academy was organized.

In view of what I have in mind to say to-day, I am particularly struck by the following words which appear in the original charter granted to the academy in 1753 by Thomas and Richard Penn:

*The well-being of a society depends on the education of their youth, as well as, in great measure, the eternal welfare of every individual, by impressing on their tender minds principles of morality and religion, instructing them in the several duties they owe to the society in which they live, and one towards another, giving them the knowledge of languages, and other parts of useful learning necessary thereto, in order to render them serviceable in the several public stations to which they may be called.*

It is interesting to note that the charter of 1755, creating the college, enlarged the scope of work to include 'Not only the learned languages, but the liberal arts and sciences.'

Since Franklin's day, tremendous strides have been made in the sciences and especially of late years in that branch in which he did pioneer work—electricity.

It is to the credit of this university that it has recognized its responsibility in connection with this advance, and has quietly progressed in the line of engineering edu-

cation until to-day we are assembled to recognize formally the addition to its educational plant of a complete engineering building, probably second to none of its kind and equipped to give adequate instruction in several branches of engineering.

Should not this magnificent growth from so small a beginning strengthen our faith and be an encouragement to all of us who are struggling to meet our responsibilities along similar lines?

There is passing over the United States to-day a wave of reform—some of it real and honest—much of it not so. To-day reform is popular and to a certain point I am willing, yes anxious, to go with the popular party.

Reform is needed, much needed, in the United States and in many directions. And reform always has been needed and always will be needed in this world of ours. Here is where the first mistake is made by the reformers. Their proposition seems to be that the conditions now attracting their attention are singular.

The people at large have been deceived as to our condition in connection with the need of reform as compared with times past. Many men of standing hold the opinion and are willing to act on the belief that the present condition as to the wrongful use of the money power is such that relief can be found only through a revolutionary upheaval. If the case is so desperate that a surgical operation is required, let us hope that our republic will not be in the position of the unfortunate patient who dies under the knife, although the surgeon declares the operation to have been successful.

And what has been the chief agency in this deception? Unquestionably, yellow journalism.

Yellow journalism of the ordinary sensational type is an old story in America.

Dickens shows us—perhaps the picture, caricature-like, is an exaggeration, but, caricature-like, it contains the elements of truth—that yellow journalism had a footing with us in the days of Martin Chuzzlewit and Mark Tapley. Comparatively, this type is harmless. But the extreme yellow journalism of to-day is something very different. We now have to face a systematic effort to deceive the people by a partial telling of the truth and an extended telling of untruth, with the deliberate intention of stirring up discontent and antagonism between classes.

Public opinion in connection with our form of government is a necessary safeguard of liberty. But to be a safeguard, it must be sane public opinion, and not public clamor instigated by a section of the press which is influential in spite of being conscienceless.

There are too many to-day who are willing to push aside their individual responsibility in this connection by relying, or pretending to rely, upon the good sense of the so-called plain people. But these yellow journals are sedulously and constantly engaged in the effort to corrupt this good sense.

Others tell us that our republic is safe in the hands of our young men. These are urged to take part in political movements and especially in movements looking to the betterment of civic conditions. Undoubtedly, if rightly employed, here is a powerful agency for good. But these young men must not be encouraged to believe that they are capable of helping the cause of good government simply because of their youth. As a rule inexperience and immaturity go with youth. If in our public affairs we need the fire and enthusiasm of youth, as we do, we also need thorough knowledge of facts, followed by their judicial application. Real reform must be based upon a careful, competent, honest

consideration of all obtainable evidence and data.

To-day, all over the land, we find indiscriminate abuse of corporations. What is fair and honest is condemned along with that which is unfair and dangerous to our national life. If we condemn indiscriminately and thus unjustly, so surely will there be a reaction, and public opinion, seeing that injustice has been done, will be carried to the other extreme and again become indifferent to real evils. And the last condition shall be worse than the first.

If wrong has been done under the mantle of trusts and corporations—and unquestionably such is the case—that is no reason that we should believe that corporations as such are necessarily evil in their work and influence. It is a commentary on the sincerity of some of the most blatant of yellow journalists that, while condemning corporations as a whole, they avail themselves of the protection to be found in corporate organization to secure immunity from personal responsibility.

And are we not forced to acknowledge, much as we may regret the necessity, that the yellow journals have been given their opportunity all too often through the hasty, intemperate, non-judicial utterances of those occupying the highest positions within the gift of the people? Are these men, occupying their high positions through the votes of the people who have trusted them, to be absolved from responsibility because they plead, or the plea is entered for them, that they are sincere in their beliefs, are personally honest in their acts and have effected reforms in spite of their indiscretions? They can not so escape their final responsibility.

It used to be thought that responsibility thrust upon an office-holder would steady him and make him a safer guide than his public utterances before election had seemed to warrant.

The effect of the present tendency to destructive criticism is to kill or at least discourage individual enterprise. National enterprise can result only from individual enterprise; and the latter necessarily is held in check and finally killed if the individuals come to believe that the government will not permit them to reap fairly where they have sown.

Much, perhaps nearly all, of the present unrest comes from lack of information and from misinformation as to the conduct of certain of our industries. The evils which flow from general lack of information are systematically cultivated by misinformation supplied by the worst of the yellow journals.

Then to-day the problem is—how shall we correct the false impressions created by those who systematically aim to deceive and by those who, while honest in intention, are not deterred from rash statements by their ignorance and inexperience?

First, we should be firm not to believe evil of any one or anything on the unsupported statements of the yellow press. Beyond that the remedy must come from the dissemination of the truth. The nation as a whole needs the honest services of those who know.

But it may be asked, why this discussion in connection with the dedication of a building to be devoted to engineering education? I will try to show in a few words that this discussion is appropriate to the occasion.

In this country the varied and bountiful gifts of nature have, in no small degree, been utilized for the common good through the efforts of the workers in pure and applied science. This country's present commanding position in the industrial field is, in considerable measure, due to the efficient preparatory work done by our engineering schools. And incidentally let me say, while all classes have, directly or indirectly, prof-

ited by the industrial prosperity of the nation, it is to be deplored that those who have acquired great wealth from industrial undertakings have *as a class* failed to show in a practical way their appreciation of their obligations to these institutions.

To whom should the public look for the facts concerning industrial undertakings? Certainly to those who are engaged in the work, who understand the underlying principles involved; who, knowing all the details and appreciating that part truth often serves to deceive, are honest enough to tell the truth, the whole truth and nothing but the truth.

During the last decade the management of our industries has been falling more and more into the hands of the men who have received a preliminary training in our engineering colleges. If this is to continue, it must be the graduates of our technical colleges to whom we must look more and more for protection from the evils to which I have referred. Questions are continually arising which can be settled only through expert advice. The people must come to have confidence in those who give these expert opinions. Unfortunately, the title 'expert' has been too often degraded by those who have assumed to speak as such. Too often our experts accept retainers to tell part only of the truth and possibly to cloud over, distort or deliberately hide other parts of the truth. Such expert advice brings discredit upon our profession and affords an opportunity which the enemy is not slow to seize.

Again, the so-called expert often errs through ignorance. It must come to be recognized within our own ranks that the fields of science and practise have so widened of late years that no man can honestly claim to be able to cover authoritatively more than a limited area of either of these fields.

There are a number of fairly well de-

fined branches of engineering, such as civil, mechanical, mining, naval, electrical and chemical. But no one man can hope even to cover authoritatively every portion of any one of these branches. To be thoroughly efficient, the engineer must closely specialize within his profession. And yet we find public opinion on intricate and complex industrial questions based upon the dictum of men who have at the best but a general knowledge of the matters involved. Especially it is to be regretted that graduates of engineering colleges, possibly competent in some one branch of the great field of engineering, presume to instruct in connection with some other branch on which their knowledge is only of a general character.

But the technical adviser, be he scientist or engineer, to serve the state as I have indicated, must have more than a knowledge of material things, he must be honest to the core.

Education is a boon. It is well for a nation that its youth should be educated, as was argued by your Benjamin Franklin and his associates. But a little knowledge is a dangerous thing and much knowledge may be even more dangerous if not built on the foundation of character.

The engineer, to be an engineer in anything more than title, must be practical. His work must be based upon correct and complete theory, but it must be first and last practical. Can the engineer—that is, the civil engineer as distinguished from the military engineer—be practical, can he economically apply the truths of nature for the benefit and convenience of mankind; in other words, can he really be an engineer, unless he is competent to practise his profession within the necessary commercial limitations and in accordance with standard business methods? Can he disregard the question of return on investment? These questions, if fairly put,

answer themselves. But still there are engineers who seem to believe that engineering is something which can be practised without regard to money values and that others can be trusted to coordinate the engineering and commercial elements of the enterprises in which they are concerned. These men may be ingenious inventors or designers, they may be great mathematicians, they may even be eminent as scientists, but they are not engineers. The man who is willing to scientifically spend a dollar to save fifty cents can not be classed as an engineer nor can he be of much assistance in meeting the present yellow-journal danger. The man to so serve the cause of truth must be fully qualified to practise his profession in conformity with the limitations of commercial and industrial practise; to the knowledge and training gained in the school of engineering he must have added that knowledge and training which is to be gained only in the exacting school of experience.

Then the question is raised—what should the college education include that is not now generally covered in the regular four years' course? First it must be acknowledged that the courses in place of other material obsolete are crowded to the point where nothing more can safely be added unless there is a corresponding elimination. Through the steady and rapid advance in engineering science we are constantly having thrust upon our attention new matter for introduction into our courses. But where this new material can not advantageously be substituted as illustrations and applications of scientific truths in place of other material obsolete through displacement, the new must necessarily be refused admission. We must encourage ourselves in the reflection that our engineering courses are, after all, preliminary, and to a certain extent, elementary, and that it must in any case remain for each student

after graduation to thoroughly learn all the details of some one—possibly narrow—branch of engineering or industrial operation. While every engineer-student should, after four years, have a good general knowledge of engineering science and practise and be thus prepared to acquire rapidly and surely a specific and certain control of some one branch of the profession, we must recognize that we can not graduate our men as fully equipped engineers, ready to assume positions of responsibility in any part of the engineering field. And are not the employers often at fault, even some of those who themselves are graduates in engineering, in expecting the young graduate to be able at once to do work which probably the employer himself was not qualified to do for years after his graduation? Is not too much expected of the modern education? There is no royal road to learning, there never will be, and no progress in educational methods will ever relieve the students from the hard work required for mental discipline and specific training. Should we not constantly bear in mind that the amount of work required in the four years should be limited to the capacity for thorough work by the eighty per cent. student?

How, then, with the four years already crowded, are we to find time to give our students some preparatory training in the branches required to enable them to take up their work in conformity with commercial requirements? First let us see if we can agree with Huxley that "The great end of life is not knowledge but action. What men need is as much knowledge as they can assimilate and organize into a basis for action; give them more and it may be injurious." Is it not probable that in certain directions we are giving our students more than they are yet prepared to assimilate and organize as a basis for action? Should they not be subjected to a

well-balanced course? Should they not then at least be taught the necessity for practising in conformity with commercial limitations and methods?

I contend that every engineer-student should have some instruction in the principles of accounting, in depreciation, business law, patent law, banking, specification, and even of sociology. And in connection with the business side of their training they should be made to see the importance of the correct use of language. They should be given opportunities to see how the work of the world is impeded and hindered through the ambiguous expression of thought. They should be taught that it is not enough to know, but that they must be able to give effect to their knowledge through the use of correct, clear, explicit and forcible language. More particularly in this business department they should be warned by those who can speak from experience of the pitfalls into which they are liable to fall and especially through the efforts that probably will be made to purchase their professional opinions if these opinions prove to be of value. Here, as in no other department, can the ethics of the profession be impressed upon the young engineer-student. As religious instruction is excluded from engineering courses, it is all the more incumbent upon us to show our students the lines along which they should practise if they wish to maintain their self-respect.

Some authorities oppose the broadening of our schemes of instruction on the score that necessarily the effect must be to make them less specific and more superficial. Others oppose making the courses more technically specific on the score that necessarily the effect must be to narrow them. I venture to maintain that the change I recommend would broaden the instruction and also make it more thorough and more specifically adapted to the needs of the

engineer-student. To reach this result the selection of matter for elimination must be made with the utmost care, keeping constantly in view the work for which the engineer-student is being specifically trained and that we are not only giving him knowledge but we are training him to think straight and that it will remain for him to acquire in the school of experience that additional training in application which can not be obtained elsewhere.

In this university you are already equipped as few educational institutions are to supplement as I have suggested the studies more directly concerned in the technical side of engineering. I refer to the Wharton School of Finance and Commerce.

Even if only one hour a week during the junior and senior years could be devoted to these economic subjects, the students would be better prepared to go out into the industrial world to promptly equip themselves to take authoritative positions, positions from which they could do much to counteract the danger arising from the indiscriminate condemnation by yellow journals of the results obtained from the combination of capital and individual enterprise working under corporate organization. Even if, with the time saved by elimination of studies of less comparative value, we could only give our students before their graduation a keen appreciation of their need of the class of knowledge I have referred to, the time would be well spent.

This is an industrial nation and the people should therefore have the opportunities to learn the truth as to the fundamentals of industrial management, and the lawmakers should have the opportunities to learn the special conditions, local and otherwise, affecting each branch of industry. This information must come from those who, knowing the truth, are willing to place it before the public. The public must first

have confidence in the ability and integrity of their informants, and here it becomes the duty of our technical colleges to train their students to take the positions in the world of industry which will qualify them in their several stations to fully serve their country as fountains of truth.

In conclusion, let me quote a passage from an address by that ardent champion of truth, Thomas Huxley, delivered in 1880, upon a somewhat similar occasion to the present, namely, the opening of the Technical College in Leeds.

\* \* \* It is not beside the mark to remind you, that the prosperity of industry depends not merely upon the improvement of manufacturing processes, not merely upon the ennobling of the individual character, but upon the third condition, namely, a clear understanding of the conditions of social life on the part of both the capitalist and the operative, and their agreement upon common principles of social action. They must learn that social phenomena are as much the expression of natural laws as any others; that no social arrangements can be permanent unless they harmonize with the requirements of social statics and dynamics; and that, in the nature of things, there is an arbiter whose decisions execute themselves.

But this knowledge is only to be obtained by the application of the methods of investigation adopted in physical researches to the investigation of the phenomena of society. Hence, I confess, I should like to see one addition made to the excellent scheme of education propounded for the college, in the shape of provision for teaching sociology. For though we are all agreed that party politics are to have no place in the instruction of the college; yet in this country, practically governed as it is now by universal suffrage, every man who does his duty must exercise political functions. And, if the evils which are inseparable from the good of political liberty are to be checked, if the perpetual oscillations of nations between anarchy and despotism is to be replaced by the steady march of self-restraining freedom, it will be because men will gradually bring themselves to deal with political, as they now deal with scientific, questions; to be as ashamed of undue haste and partisan prejudice in the one case as in the other; and to believe that the machinery of society is at least as deli-

cate as that of the spinning-jenny, and as little likely to be improved by the meddling of those who have not taken the trouble to master the principles of its action.

ALEX. C. HUMPHREYS.

#### SCIENTIFIC BOOKS.

*Entomology, with Special Reference to its Biological and Economic Aspects.* By JUSTUS WATSON FOLSOM, Sc.D., Instructor in Entomology in the University of Illinois. Philadelphia, P. Blakiston's Son and Co. 1906. \$3.00.

There is supposed to be a growing demand for a biological treatment of entomology, and two notable efforts have recently been made to meet it. Professor Kellogg met it in his 'American Insects' by adding to the systematic treatment of the older standard texts (which he incorporated *in toto*) a few chapters on color, insects and flowers, insects and disease, etc., making a very big book of the encyclopedic sort. Dr. Folsom has followed the plan of cutting down to an almost negligible quantity the systematic part, giving a condensed résumé of anatomy, physiology and embryology, and devoting the greater part of his book to the discussion of general biological phenomena, making it a reading book of comfortable size. Thirteen pages of systematic description of the orders serve to eliminate that part of the subject (which, according to the preface, is thus summarily dealt with because of its prominence in other available texts). The condensation is at its maximum in the description of the larvæ of the orders, for which purpose two words, *thysanuriform* and *eruciform*, suffice. The theoretical significance of these terms is explained in the chapter on development: but here in the descriptive part they are very much over-worked. To say merely that the larvæ of the Odonata are thysanuriform is certainly not very illuminating. Only with the mind's eye could one see, for instance, anything thysanuriform in the larva of *Hagenius*.

The chapters on morphology and development (158 pages) are concise, well digested and altogether excellent, and taken in connection with the well-selected bibliography at the