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THE ENGINEER AS A SCHOLAR AND A GENTLEMAN.

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(President 1889-90.)

FAR back among the ages, in times beyond the ken of History's written page, the young world invented the *Engineer*, as the creator of its coming civilization. He it was who established synthetic methods, and sewed together fig-leaves into a mantle which was a prototype of our textile fabrics, and, in analogous metal patchwork, our steam-boilers and ship-hulls of a later age—one large piece made from many small ones. He it was who, with sticks and puddled clay, established the first order of architecture—Adamesque, if we may so call it. He it was who, before he happened to think of a Pullman car on a steel rail, built the roads and rude wagons which made the dawn of commercial and social life possible. He built the bridges which brought tribes and nations into communion, and helped them to reduce their uncomfortable excess of population by making machines with which they could kill each other.

Throughout the earth, in all ages, the *Engineer* has wrested from nature her well-kept secrets, and has made his non-engineering friends comfortable by showing them how to deal with the material world around them. But for him, as we now know him, practising his art in its present stage of development, we should be set back a century, without railways, or telegraphs, or steam-power manufactories. There would be no electric-lights, nor telephones, nor electric-bells; no sewing-machines, nor gas-fixtures, nor modern plumbing. Our farmers would work with the sickle and the flail; our sailors, as of old, would keep us tossing months, instead of days, upon the sea. Following time logically backward, and robbing each age of its ministering angel, with his

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acquired knowledge reënforcing the accumulated experience of his predecessors, we would soon arrive at the blackness of social darkness. We can therefore say that were it not for the *Engineer* in history, our fashionable society would probably all be modelled upon that of Terra del Fuego, where an entire wardrobe consists of a piece of fur, held upon the *windward* side of its wearer. Our roofs would be the caves and trees; our food, shellfish and fruits and nuts—good enough dinner courses in their way, but not followed by champagne; our roads would be but foot-trodden paths; our bridges fallen logs; our weapons stones and clubs.

So much for a cursory negative view of engineering in the past. A positive exposition, in a concrete form, even if for a limited period of time, might occupy too many pages should I follow what has been a frequent custom in this Society, and an obligatory duty in one at least of our American sister societies; namely, to make the annual address a *resumé* of the important engineering news of the world for the preceding year. Tempting to an essayist, and interesting in itself, as this field may be, I venture to leave it to be harvested by our members with their individual sickles—or should I say self-binding automatic reapers?—that I may touch upon a theme which, though not less important, is less often brought to your attention. This I feel the more willing to do, from the fact that I have more than once been requested to make public certain views which I have at various times strongly expressed in private conversation.

The term *Engineer*, the subject of my title (and of the foregoing brief historical sketch), should, to my mind, include in the person described thereby all the attributes implied in the two nouns which follow. If it always had been thus inclusive, then that higher professional standard would have been attained which our clients in the world outside demand, as well as our own interest and happiness, and this essay would have remained unwritten. Assuming that the great majority of the men who are styled, and who style themselves, "engineers" are really worthy of the title—that in some one or more of the numerous departments of their calling they know how to get the better of Dame Nature, so to speak, by designing and constructing a good road, or bridge, or railway, or canal; by locating and digging a good mine, and knowing what comes out of it; by planning and building a good machine, without the scrap-heap's credit-entry showing more avoirdupois than the bill of lading;

by taming the lightning as a gentle beast of burden in its modern harness of copper and silk and iron ; by creating beautiful buildings not of the order of the ephemera ; the following questions arise :

Does this aggregate mass of engineers attain to as high a professional standard as, all things considered, our modern civilization would lead us to expect? Does this body of men, who, without question, are of vastly more importance to the world than those of any other one profession or trade, stand as high in the estimation of their fellow-men as their important position would seem to demand? Is their craft (one which, if properly practised, requires as much learning as do the crafts of law or medicine) thoroughly recognized as one of the learned professions?

To these queries we engineers cannot, unqualifiedly, give an affirmative reply. In the first place, we do not in all cases make high enough and absolute enough our standard of qualifications for admission to our ranks. In the second place, we do not have our forces systematically organized into a mighty army, with unbroken front, which would compel, to a proper degree, the admiration and respect of the non-engineering world for the profession as a whole. We have, on the contrary, been fighting too much upon the guerilla principle, and have too often shown the world brilliant dashes by individuals, unsupported by the great body of their fellow-fighters. In a retrospective glance through history, we may perhaps trace some of the causes which have prevented engineering from being definitely organized as a learned profession in early times. Among these causes was possibly the fact that the men on whom alone, among the intellectual classes, devolved the bulk of the hard work of the world's advancing civilization, the engineers and architects, were too busy even to cultivate each other's acquaintance, to say nothing of that of the lazy kings and knights and priests, who were the leaders of influential society. In times of war these kings and knights—lazy no longer—called upon their men of practical science to build their roads and forts and towers, their ballistas and their catapults. Thus arose the military engineer. He was far too important a man to have his eyes put out, or to be walled-up alive in one of his own buttresses, after the completion of his first valuable piece of work, as had been the pleasant experience of some of his civil brethren. He grew to rank with other high officials of the army

which he helped to keep in existence, and organized his work after the methods of his fellow-soldiers. Hence the systematic education and training, the *esprit du corps* and high professional status, of the body of men who should in some respects be the model for the now larger body of their lineal descendants, the civil engineers.

I here use the term "civil engineer" in its general, rather than its restricted, sense; and it seems to me that we Americans should follow the practice of our European brethren in giving to the word "civil" its proper and original meaning—simply "non-military." It is bad enough, in these days of friendship and earnest coöperation between our government engineers in both Army and Navy, with the much larger body of those in civil life, to have the general distinction between military and civil. The classification is not a logical or scientific one, as much of the work in these different branches is identical. A military engineer, in these times of wonderfully rapid mechanical evolution, must be a good deal of a machinist and electrician and aeronaut, as well as a digger of ditches and builder of forts. Even in the last mentioned work (the one thing which distinguishes him from his civil brother, and which the latter is supposed to know nothing about), his knowledge is becoming very uncertain; for the conventional science of fortification, with its visage grim of brick and granite, seems to be crumbling into *débris* and ashes, from which the young phoenix of mechanical engineering shall spring with a shining countenance, bearing in its lineaments the similitude of nickel-steel.

From this general view of the case, it would seem that the profession as a whole should designate its members by the simple word "engineer." The public would in time follow this example, but, meanwhile, persistent and organized effort should be made to discourage the "Americanism" of using the word to describe the driver of a locomotive or the engineman of a factory; nay, even the clodhopper who stuffs straw into the fire-door of an agricultural engine, smears lard upon its feverish journals, and hangs his boots and jacket upon the safety-valve, for a maximum test of the elastic limit of the boiler-shell.

Allowing the distinction between military and civil work to be expressed only when necessary, it seems to me that the normal use of adjectives as prefixes to our general name should be simply for classification into specialties of practice, as topo-

graphical, mining, metallurgical, mechanical, electrical, hydraulic, railway, bridging, architectural, sanitary, etc. These terms are written in a somewhat natural order of progression from nature to art; but are not, of course, in strictly logical form and sequence. This and the preceding paragraphs may be somewhat in the way of a digression from my subject, but are in sympathy with the general idea intended to be expressed of fixing a definite status for the man (or woman, if she be so minded) who shall be called an engineer. Having briefly and sketchily traced his past history and present position, let us, following the *motif* of my title, see whether the term "engineer" includes those of "scholar" and "gentleman." If such is not wholly the case, how far should it do so, and how may it be made to?

As a matter of fact, the modern engineer, if he be worthy of the name, must be a scholar as regards many important branches of knowledge. To have become this, he must possess a trained intellect and must have been through a course, whether in college, or office, or shop, in which he has fulfilled the most important condition of all scholarship, by learning how to learn. The particular branch of learning into which his natural talent, his inclination, and the necessities of his chosen profession have led him, will have required as much study as if he had, for a specialty, chosen Sanscrit, or archæology, or astronomy, or Spanish literature.

In stating the case thus, I do not wish to disparage classical learning. If a young man about preparing for any branch of engineering has time and money enough to take a classical course in addition to the scientific course, which is absolutely essential (if not at college, then at home, or somewhere else), so much the better. The delay of a year or two in starting upon his practical life-work will be well paid for by the increment of mental culture obtained, and by the additional opportunity for class friendships, in after life, with scholarly men, who are not running exactly in his own grooves of thought. If, however, he can by no possibility give to the schools all the time necessary for both courses, let him go through the scientific course thoroughly, remembering the masterly epigram once uttered upon an occasion like this, by my talented predecessor in this chair, Prof. Sweet, which, as I remember, ran thus: "Tis better to know *what* wants to be done, and *how* to do it, than to know what *has been* done, and *who* did it." Surely, no comparison between the

study of practical science and of history in literature could be more crisply, yet more powerfully, formulated.

Our embryo engineer should not, however, take sides so strongly in favor of pure science as to ignore entirely the claims of polite literature. Too many of our young men who are faithful students and earnest workers, but who are too poor to take a full college course, or who, yet more unfortunately, can take no course at all, beyond the common school or academy, are apt to imbibe a contempt for *belles-lettres*, and even, in some cases, for the shade of Lindley Murray himself. They wish to be intensely engineers, and are willing to be nothing more, ignoring social life and other pleasures in their zeal for their chosen work.

To such young men the advice cannot be too strongly given : Do not limit your future happiness and that of your friends and associates by becoming mental hermits—one-sided, unsymmetrical characters, with ideas running in a single groove. Not only for your social happiness, but for your professional advancement, for your worldly prospects in wealth and reputation, make yourselves fit to appear as educated men of the world, not in the bad sense of being familiar with its vices and ready to sneer at its homely virtues, but in the larger sense of being ready to meet men anywhere, of any degree, upon their own ground, familiar with their methods, and acquainted with their ways. For all this you need not be able to instruct a learned Rabbi in deciphering Hebrew inscriptions ; nor a Harvard professor in extracting Greek roots ; nor even an astronomer royal, regarding the width and straightness of the bands on Mars ; they could not tell you the area of an anchorage-plate in your suspension bridge, or the best diameters for the piston-rods in your latest triple-compound engine. You should all four, however, be ready to meet on common ground at your club, or in each other's drawing-rooms, and be not wholly at sea should discussion arise about Shakespeare's iconoclasts ; or the most-talked-of article in the last *Nineteenth Century* or *Forum* ; or as to *how* American was last week's *American Order of Architecture*, as exemplified in some fearfully and wonderfully made new public building. For all this, it is not absolutely necessary that you should be able to translate even a page of Homer into flowing English rhymes.

Continuing the imperative mood, the advice to our hypothetical young man would be more definitely formulated : Before you begin engineering, ground yourself with a thorough English

(if England or America be the home of your birth or adoption) common-school or academical education, learning as much of the classics and of modern languages as time and circumstances may permit. For your professional training, enter the best technical school, college, or university available, the larger and more fully equipped it is, the better. Adapt your personal course of study especially to the branch of engineering which you intend to follow, bringing in as much of the classics as may come, without hampering your science. If your time for languages, dead or alive, is limited, choose German, French, Latin, Greek, in the order named, unless you need Spanish, Italian, etc., for local reasons. If the curriculum of your school does not include ample practical work in field, shop, mine, or laboratory (according as your future work may lie), take care to have had enough such practice, either before, during, or after your school course, as to amount to three or four solid years of such work, before you announce yourself as a practising engineer. In addition to this, do not neglect your commercial education, if possible spending such time in store, bank, or counting-house as will give you a general idea of accounts and commercial law. In these days an engineer must be a man of affairs, and must be something of a merchant and lawyer, as well as a scientist. With all this, keep in mind, as before indicated, the great importance of writing and speaking your own language correctly, and of attaining at least a cursory knowledge of general literature, and something of the shibboleths of cultivated society.

So much for the engineer as a scholar. Answering a question propounded earlier in this essay, I will express the opinion that the best modern engineering courses of study do include such scholarship; and that the great majority of studious men who have been fortunate enough to graduate therein, with their culture supplemented by a few years of active professional life, whether as manufacturers, consulting engineers, or what not, may lay claim to the true scholarship, which consists of a general knowledge of the world at large, combined with such particular knowledge of, and experience in, their chosen vocation, as to make it a success. That minority who have not reached the ideal just pictured, though perhaps more or less eminent technically, are either men who have fought their way up through early disadvantages, or men who, having had the advantages, have a natural distaste for the refinements and amenities of intellectual

and social life. If eminent, they are so in spite of this neglect, not because of it. Happily, our modern technical schools, a course in which is now considered almost essential as a preparation for any branch of engineering, are creating a new and higher standard than did or could exist even a score or two of years ago, especially in the case of mechanical engineering. Many of us now only in middle life can remember the times when this branch of the profession had hardly begun to be a science, and but very crudely was an art. Not so very long since our machinery was designed, empirically, by the machinists (or white-smiths, as the English termed them), who were to build and operate it. A mere shop experience was considered sufficient education for these designers, and the resulting machines showed their fatherhood. Their chief pride was to be "practical," and they vied with each other in scoffing at theory and at science. Unfortunately, some of these men are alive yet, and are still at work. Mechanical engineering as a science has, however, sprung up like a young giant ready for the fray. Its influence has pervaded all other divisions of the profession, until the "civil," the mining, and the electrical engineer are largely dependent upon its methods and its men. The scholarship which, but comparatively a few years ago, was monopolized by the older branches of the engineering family, has become necessary to all; and the time will doubtless soon come when nobody will attempt to practise without having enjoyed the rigid training and culture of the schools, or, at any rate, such private training as will pass their examinations.

Having seen that an engineer who is worthy of the name generally is, and always should be, to a greater or less degree, a scholar, we come to the more delicate and difficult question suggested by the title of this address: Is he, or should he be, a gentleman, in the highest and most perfect sense of the word? So embarrassing is this matter that I feel loath to speak of it, and do so only with the hope of adding my mite of influence in favor of the good work, which is already in progress, of elevating the tone and standard of the *personnel* of our noble profession to the highest possible degree, intellectually, morally, physically, and socially.

To the second portion of the query propounded in the last paragraph, we shall all without doubt unhesitatingly say yes! No standard of gentility, no patent of nobility, can be too high

for a profession which leads the civilization of the world, and which is probably destined, in the not too far off future, to mark out pathways of material and moral advancement in the life of the race, which are beyond all our present conceptions. Taking a lower and merely selfish view of the case, there can be no question about the great advantage which will accrue to the engineer, in common with the architect, the lawyer, or the physician, from the ability to meet his wealthy and cultivated clients upon their own level; to excel them, if anything, in the intelligent appreciation of their mutual affairs, and in the amenities of social intercourse. This social aspect of professional work, and its great importance in furthering his success in life, not only in the way of pleasure, but of profit and reputation, is too often ignored by big-brained young men who are full of scientific zeal, but who have not learned sufficient practical respect for the ways of the world.

Answering last the first portion of our query, we may all congratulate ourselves that engineers as a body rank high as gentlemen the world over. There are, of course, exceptions, as there are in all vocations, whether with priest or doctor, counsellor or gowned judge. Happily, the tendency of an engineering education is to refine, rather than coarsen; and this is, I think, the case with the study of science in any of its forms. As we have seen that the very name of engineer is apt to include and carry with it a fair degree of scholarship, so this scholarship carries with it and includes a certain inherent gentility, just as does scholarship in other and quite different branches of learning. Engineering has, however, the advantage enjoyed by other purely scientific studies; it commands an absorbing interest in its devotees which entices away from frivolity and dissipation, and the dealing with pure truth and with the resistless logic of nature leads to veracity and accuracy of character and speech. Who, that has mingled freely in engineering circles, has not noticed the comparatively high moral tone and solidity of character prevalent in their *personnel*? Temperance in all things is in the very nature of the engineer's daily line of thought. He is too much accustomed to trace carefully every effect to its cause, and to modify his causes that his desired ends may be accomplished, to fall an easy prey to dissipation of any sort.

So firmly do I believe in the elevating tendencies of our profession that I might well have added to my title the words "and a

moralist." Not only do the studies of the votaries of science tend toward scholarship and gentility, but toward morality; and these attributes act and re-act upon each other. Science is truly the handmaid of religion; "her ways are ways of pleasantness;" she seeketh but the things that are true, "that are lovely, and of good report."

Assuming and believing that the status of engineers as a body is good, and that on the whole we rank before the world with other learned professions, the question arises just as it does with one of our "perfected" machines): "How can we make it better?" How can we outrank all the others, and make ourselves fit to stand before the world so that it will acknowledge us as the leaders of its advancing civilization and large factors in it, as openly doing what we really have been doing *sub rosa* through all the passing centuries? How shall we make it consider us, when in properly organized form, a body so wise and powerful as to be fit advisers not only in matters of applied physics, but in social science, in commercial economics, and perhaps even in politics itself (if that subtle profession is not killed out by that time)?

And why not such added functions? They fall within the line of thought which I have projected—a line reaching from before the dawn of history to a bright era in the future, when the affairs of men shall be run on the engineer's time-table; that is, by the rules of common sense. This, being interpreted, doth mean simply that we shall try to win nature's gifts by using nature's laws, not by controverting them.

Answering the questions above propounded, as to how we can in all ways elevate our professional standard, I will suggest that the best way is to have a standard, and then to elevate it. To do this we must have such general organization as will give concerted action, and then command general respect. Furthermore, this standard should have some sort of a legal status, at any rate as regards its minimum limitations. Just as firmly as I believe that no doctor, nor architect, nor lawyer, nor chemist, should be allowed to invite fees from the public, without first passing an examination and receiving a degree from some reputable school, which, in its turn, should be subject to examination and regulation by the general government as much as should a national bank, so do I verily believe that the practising engineer should be authorized to be such by some higher and more uniformly acting power than his own choice. Not only do we want such

regulation for the protection of the public, but more particularly for our own protection, that we may not suffer from the charlatans and quacks who infest our ranks, with symbols ending with an E appended to their names. We may not yet be ready for any such system of unification, but it seems to me that we should *build* toward something of the kind in the future, as the surest way of fixing our status in the eyes of the world as belonging to one of the definite and recognized learned professions. Should such a system once be established, there would be no more chance of a reversion to the present systemless style than there is of our American national banks changing back to the old-fashioned "wild-cat" banks of forty years ago.

In the meantime, whilst we as a body are educating ourselves up to, and preparing for, some scheme looking toward more unity, power, and usefulness, how shall the average tone of the profession be improved by the cultivation of the individual? Here the advice regarding the Scotchman in the story may be followed: "Catch him young." The rising generation of engineers must be trained to higher ideals than has been any preceding one, and this is largely the work of the schools.

We have, in this country, many excellent technical colleges. Generally speaking, their standard of scholarship is high, their methods thorough. Their chief fault is, perhaps, lack of uniformity with each other, in certain things where standard methods of study and experiment would be desirable; and, more important yet by far, some standard regarding the conferring of degrees. The evils due to these sins of omission may perhaps be remedied by some system of official conference between their respective faculties, some intellectual "pooling of their issues," so to speak. Not only would this be productive of uniformity where uniformity might be an advantage, but it would improve the average character of the schools themselves, and tone up the weaker ones by exciting a spirit of more active emulation.

We have assumed that our coming engineers, many of whom are now in our colleges and "institutes" training for the development of brain and eye and hand, will there find all needful helps to the scholarship which is to prepare them for their calling. They will there be trained, also, to some extent, in manners and personal habits, both by precept and example, especially those of them who, by reason of poverty or geographical isolation, have not had the early advantages enjoyed by some of their more

Chesterfieldian fellow-students. Recurring once more to the second natural attribute of an engineer mentioned in the title, we may ask: Do these schools establish and maintain the high standard which they should do in regard to good breeding, elegant manners, tasteful costume, and those graces and accomplishments which, as before intimated, will so much aid any professional man in gaining the desirable prizes of life? The answer must be, that our civil schools do not, to the extent they might, provide this culture as yet.

In this respect they should follow some of the methods of governmental military and naval schools, whose curriculum includes not only a rigid technical and professional course of study, mingled with enough of classical and general literature to cultivate the mental graces, and a superabundance of military drill and other *systematic* physical culture for strength and grace of body, but also instruction and practise in dancing, in dress, and in the nameless other social arts which make for politeness and refinement. Nor do we see that attention paid to these matters in any way cuts short the more severe culture which is the chief aim of education. To disprove this we need but think of the long list of names, which it would be invidious to specify, among the regularly educated army and navy men of this country and Europe who have become distinguished in science and in general engineering.

We cannot take all our young engineers from cultivated homes and teach them only technics. Many are blessed with such homes, but many others must come from orphan asylum, from factory, from distant farm. We are all, in a certain sense, children of the people. Class distinctions are gradually disappearing not only in America but in Europe and the Islands of the Sea. Notably is this the case in what we may almost term our sister republic of England. The ultimate social distinction will simply be between gentlemen and non-gentlemen. Only the men with sufficient "voltage" of brain-power will survive in the struggle for a properly standardized engineering education. If they happen to need it, why should they not incidentally receive, as they pass through the mill, the polish of gentility?

It is an observed fact, that many a mere "cub," drawn from his lair in backwoods or mine by some benevolent congressman, and entered at West Point or Annapolis, has, if showing brains enough to go through at all, been turned out a scholar and a gentleman.

He, throughout his after life, mingles with ladies and gentlemen, is one with his fellow-officers, for nowhere is *esprit du corps* stronger than in army and navy circles. Let us do likewise with any engineering cubs that we may catch. Let our schools imitate successful methods wherever found. Let them throw such a mantle of refinement over each of these young men as not only to conceal, but to absorb his cubbishness. Make him not alone truthful, temperate, scientific, skilful, business-like, scholarly; but healthy, erect, graceful, socially accomplished, possessing "manner," as well as manners. Give him a love for moral and physical cleanness—morally a cleanness shining out from soul and mind, and physically one which shall be manifested not only upon his face and upon his shoes, but shall reach even to the tips of his fingers. Give him a horror of careless pronunciation and orthography, but such a practical respect for etiquette and fashion as will cause him to use either at will, as an expedient tool, while, perhaps, contemning it theoretically. Teach him that there is raiment fit for the morning, and raiment meet for the evening; or, at any rate, that he may find chances to make some pleasant hostess happier by assuming such a proposition to be true, whether it be strictly logical or not. Search the effects of a youth thus trained for personal and well-used implements of his calling, and expect to find not only tape-line and calipers, but a thumbed-up volume of Shakespeare or Emerson; not only a two-foot rule and an "aneroid," but a card-case and the accessories of a dainty toilet.

The general and social culture which our schools should provide for these young men cannot be a matter of precept only, but must be one of example also. There must be a high standard among professors and instructors as well as among students—not only in scholarship, but in manners and morals. While speaking again of morals, as among the attributes of a gentleman, I fain would utter an earnest plea for the nurture and cultivation of that knightly sense of personal honor which is regarded all too lightly in the money-getting strife and turmoil of our modern commercial life, but which possibly we may find more prevalent in military than in civil society. Such honor is above all bribe-taking, and should be sacredly held as a part of the capital of every engineer. It should keep him (if for his reputation's sake only) infinitely above the consideration of such loot, for example, as commission upon material, the sale of which might be affected

by his professional opinion thereupon. It should lead engineering influence to reform our wretched system of expert testimony, wherein two reputable scientific men are paid by interested clients to draw two opposite sets of conclusions from the same premises, instead of being paid by the courts to tell the truth, as should be the case, and will be—when we engineers make it so. This high honor, and the gentle courtesy by which it should be manifested, are but the “applied science” of that *Golden Rule* which was preached by the Greatest of Gentlemen, in Galilee, eighteen centuries ago. It merely causes us to treat all men and all women as we ourselves would be served by them. Shall not our schools include it, more definitely than now, among the things which it is good to learn?

Catch we thus young the rising generation, thus lead them and guide them toward the highest possible ideals of morality, science, work, scholarship, and gentlemanhood, meanwhile organizing our forces by standardizing our methods, and by federating our societies, great and small, for unity of action in matters where unity may seem desirable (but retaining their autonomy for local and departmental objects), and the early half of the twentieth century will see and recognize a noble guild, girdling the earth both intellectually and materially, whose power and influence will lead mankind forward, yet more than in the long past, toward all that makes for prosperity, for purity, for pleasure, and for peace.