Summer 6-1909

Volume 18 - Issue 10 - June, 1909

Rose Technic Staff
Rose-Hulman Institute of Technology

The Rose Technic

Vol. XVIII | Terre Haute, Ind., June Supplement, 1909 | No. 10

RESULTS VERSUS IDEALS IN TECHNICAL EDUCATION*

By Robert Fletcher, Ph.D., C.E.

Director of Thayer School of Civil Engineering, Dartmouth College.

Results vs. ideals; performance vs. promises; accomplishment vs. good resolutions; graduating classes vs. college catalogues and prospectuses;—such is life!

This is a commemorative occasion; a twenty-fifth graduation; a proper time to look backward and revise educational estimates.

Chauncey Rose, the revered founder of Rose Polytechnic Institute, had very definite ideals. His thought was of an education blending the industrial sciences with advanced academic and even collegiate instruction; the product to be, not scholars only, but men fitted for various mechanical, professional and industrial pursuits, and equipped with both intelligence and skill.

The first President of Rose Polytechnic, the lamented Dr. Charles O. Thompson, came here with very practical ideals, worked out during fifteen years at what is now the Worcester Polytechnic Institute. He transplanted to Terre Haute the system by which adequate scholarship is joined to skill gained by manual training in shops and laboratories. The Russian system in Moscow was contemporaneous; but there all manual operations of shop work were for instruction only; material was consumed, but for the products there was no use or commercial value. Prof. Calvin M. Woodward, in St. Louis, had also worked ten years on the manual training system, in which he aimed to teach tool theory and mechanical analysis apart from ordinary shop practice; to conduct a secondary school with a liberal course of study in mathematics, science and language. But the Worcester system developed by Thompson and Higgins gave shop training under commercial conditions; the salable products had a widely-recognized use and value.

In his inaugural address, President Thompson clearly set forth the purpose and scope of an institute of technology. He defined the term

* A memorial address on the occasion of the twenty-fifth graduation at Rose Polytechnic Institute.

technology as the application of the sciences to industrial ends. He then deprecated the confusion of ideas which would apply the term, technical education, to *any* course of teaching which aims at a directly *practical* result, as opposed to the old academic idea of the "college education." But when, as he said, a title is sought for those who engage in the higher occupations or professions, the word *technologist* is found to be too vague and awkward; hence such men are termed engineers, and the business engineering.

We may note here that the term "engineering" may seem to lack breadth of meaning, suggesting chiefly mechanical devices, engines, machine shops, etc. But reference to the dictionary will set us right; for the first definition (now obsolete) of engine is "natural capacity," "ability," "skill"; and the derivation is from the Latin *ingenium,* which is a composite of *in* and the root of *gignere,* to produce. Hence the original sense is very comprehensive, and the word, as used, quite appropriate. Indeed, the late George S. Morison, Civil Engineer, held that every engineering work is a tool for accomplishing some specific purpose; that engine is but another name for tool; that the business of an engineer relates to tools; that a civil engineer must be capable of designing as well as handling tools; that the highest development of tools is an engine which manufactures power; that we are in the early stages of a new epoch, that of the manufacture of power; that civil engineering in its true meaning embraces every special branch; that the true civil engineer must be able to design as well as direct; and that, whether he be a railroad builder, a skillful surveyor, a mechanical engineer, or devoted to any other specialty, he must be more than a skillful workman—he must be an originator, a creator.

In President Thompson's statement of the high purpose of Rose Polytechnic, he recognized this principle and emphasized it by announcing that the young men who propose to be civil engineers will spend part of their practice time in the machine shop. This was then an unusual policy in the schools, but it accorded with the earliest precedents of the profession. The first great civil engineers of the modern world, Perronet, in France, and his contemporary, Smeaton, in England, one hundred and fifty years ago, developed marked inventive power and skill along mechanical lines. They devised and adapted their rude auxiliary machines for constructive purposes. Instead of steam-hoisting engines, they had only man power and steam power. Smeaton constructed and operated pumps, water wheels, blowing engines and windmills, and invented astronomical and meteorological instruments.

You may remember the familiar anecdote of Rennie, who, when traveling, lost caste among his fellow passengers by mending the broken axle of a disabled stage coach; but one offended companion was astonished to find him at the breakfast table of a nobleman next day.

To justify his ideals at that time, President Thompson reported, as the results of fifteen years' trial of the system, that more than 95 per cent. of the graduates at Worcester were in occupations for which their training had specifically prepared them. The subsequent twenty-five years at Rose Polytechnic show that eighty-six per cent. have been and are devoted to pursuits relevant to the training received here, including electrical engineering and architecture, which have been added during the period.

But a world-wide view of the ever-expanding field of technical education shows some complexity; there is discordance of results and ideals; criticism is abroad. The president of a leading American university,* where science is the leading interest, has recently recognized a prevalent doubt whether scientific studies have the same educational value as the classical curriculum; whether they confer the same depth and breadth of intellectual power; whether the outlook they give is as wide, or the life as large as that

* President Remsen, of Johns Hopkins.

founded on the old college training. Cecil Rhodes, an Oxford man, a phenomenal man of affairs, and would-be empire builder, gave his answer by founding the Rhodes Scholarships. However, to say the least, such criticism is quite premature. The ancient order or education was a growth of centuries; the new is scarcely half a century old. The immense body of knowledge, with its useful applications developed by scientific inquiry during the past two centuries, has but little relation to the ancient learning based on literature, rhetoric and art. The old system produced and still produces too much ineffective culture.

It is almost beyond belief that two distinguished professors in great universities have openly declared that increase in the utility of studies makes them of less value in educating men; and that "the practical aim of a *general* education is such training as shall enable a man to devote his faculties to matters which of themselves do not interest him." One of our honored leaders has termed this "superb foolishness." The modern scientific training aims at efficiency. If there are defects, the remedy is not in going back to the old, but in making one reinforce the other, and in finding a right adjustment of all the complex terms involved.

Perhaps it was a sense of the growing complexity of the situation and a need of some agency of adjustment that led to the formation of the Society for the Promotion of Engineering Education in 1893. This is the first and, so far, the only society of its kind in the world,—a national congress of the teachers of engineering. The choice of its title raised the old question of education *versus* training. Warning was urged against the danger of putting too much emphasis upon mere training to the neglect of the broader education. Furthermore, was the purpose of the society more truly expressed by the word "technical" or the adjective "engineering"? It was decided that engineering includes technical, in describing the professional endowment of the man; and that education includes training, as the whole includes the parts, without putting too much stress upon mere drill and manual dexterity. Dr. Calvin M. Woodward, of St. Louis, has well said that the watchword of engineering education is SERVICE. It is to be in itself essentially serviceable. "The idea of service underlies every detail of it, and that service is objective, altruistic; and therein it differs from that older education whose supreme object is 'culture.' * * * * * We all know that there is more than one avenue to culture; in point of fact there are many avenues, and we purpose to claim for the accomplished engineer his right to full and equal membership in the increasing brotherhood of culture."

Indeed, the term profession, as a vocation, signifies the application of special knowledge and skill for the use and benefit of others, and not for merely personal advantage. So that a so-called professional man whose sole aim is selfish gain is discredited. Hence the famous maxim of Smeaton reveals the true professional instinct of the engineer. He said: "The abilities of the individual are a debt which he owes to the common stock of public happiness."

Right here we may observe that the most practical product of culture for the engineer is literary ability. From the time of Smeaton's report on the Edystone lighthouse, to the latest papers and articles in our technical publications, the writings of engineers lose nothing, but sometimes gain by comparison with other literature of like kind. Instead of creations of sentiment and fancy the engineer deals with plain facts and procedure; knows exactly what he wants to say, and is only concerned to express himself with brevity and effectiveness. His subject-matter almost naturally leads him to adopt the prime qualities of style. He may be classed with other scientists who, in the words of another, "have caught with remarkably close ear the accents of the English tongue."

Doubtless this ability must be cultivated;

young graduates do not often have it, for they lack the first essential of having something worth while to say. But they may, and ought to have the preliminary training derived from preparation of required reports on special topics and the graduating thesis. And many older engineers might have more influence and better professional standing by judicious speech and writing. They hesitate to "speak out in meeting" when it is their duty to inform the community on questions of engineering in relation to public affairs. The late Mr. Eads was a forceful writer and speaker; otherwise he never would have persuaded Congress to authorize the construction of the Mississippi (South Pass) jetties against the opposition of those who advocated the ship canal.

Deficiency in this particular has prevented capable and worthy engineers from gaining proper recognition. So long as the majority of engineers are content to take the attitude and play the part merely of the "hired man," so long will capitalists, lawyers and politicians "run the business" and dictate terms to those who, by their special knowledge and skill, are entitled at least to equal voice in council, and often to direction of affairs.

The sixteen annual meetings of that society, or congress, have brought together representatives from institutions variously organized and conducted, in widely-separated localities, and with very different environments. Committees of investigation have made extended inquiries and rendered reports; vital questions of general policy and methods have been discussed, and much attention given to details of courses and subjects of instruction. A very brief statement of some of their findings will make the present situation more apparent and elucidate our theme.

1. Entrance requirements were formulated by a committee which made the ideal too high. In mathematics, they included much of what is known as higher algebra, advanced trigonometry, and facility in use of logarithms; also, a wide range of physics and chemistry, and extensive work in modern languages. Here was manifest the influence of the extreme dictation of the colleges and universities to the secondary schools. The protest of the latter has become very loud, both in teachers' conventions and in current periodicals. Studies that belong in college, perhaps to the extent of half a year of time, are crowded back upon the high schools and academies which can not properly do the work, both because of inadequate teaching force and immaturity of many of the scholars. A writer in a leading magazine for May has charged the higher institutions with ruining the high schools by diverting their strength and chief endeavors from the many pupils who can not go to college to the few who can. He says the people who build and maintain these schools at great expense are being cheated out of their proper return by not getting the education best adapted to their needs. A few years ago, the speaker saw an examination paper for admission to our foremost university, requiring solution of a problem in organic chemistry, which the instructors at one academy said would be a hard nut for them, and would require considerable time and some laboratory work for a proper answer.

2. The question of specialization and too much diversity of degrees has received earnest attention. A committee reported that, in 1904, no less than eighty-five different kinds of engineering degrees were offered, twenty-two for postgraduate work and sixty-three for undergraduate. Among these were Bachelor of Arts in five branches, Bachelor of Engineering in four branches, plain Bachelor in nine branches, Bachelor of Philosophy in five branches, Bachelor of Science in twenty-eight lines, including textile industry, sanitary and domestic science and naval architecture, railway, architectural, municipal and sanitary engineering; four Doctors and four Masters of different designations; seven Masters of Science in different lines of engineering, and nineteen others, including practical chemist, master of mechanic

arts, irrigation engineer, marine engineer, chemical engineer, architect, civil engineer in architecture, architectural engineer, etc. Only twelve of the postgraduate degrees, and *only* forty-seven of the undergraduate degrees were conferred. That is about two-thirds of all those offered. It would perhaps be unkind and inconsiderate to describe this as *absurd* variety; it certainly indicates hopeless diversity, not to say confusion of ideals. The writer has elsewhere urged that the titles Master and Doctor in engineering are superfluous, and that it is a mistake to depart from the simplicity and dignity of the titles: Civil engineer, mechanical engineer, mining engineer, architect, chemist, or, if you please, consulting chemist, electrical engineer and, possibly, one or two more.

Thousands of graduates from engineering schools during fifty years have proved that men with thorough knowledge of the fundamentals find occupation in all branches of engineering, irrespective of the kind of *degree*. Yes, looking back a century, to the first forty years of the United States Military Academy, we find about fifty men (trained to be *military* engineers) becoming chief or resident engineers on the canals and railways built in that period. Among these was Major Whistler, who built the railroad from St. Petersburg to Moscow, 400 miles, for the Russian Government. Why, then, give men such distinctive and wordy labels, as though the school had cast them into molds or already projected them with correct aim at definite targets?

3. On the question of graduation requirements the president of one of our older engineering schools protested strongly against the tendency to "the crowding of the curriculum"; another against too much attempt to anticipate for one who is yet a student, and whose future can not be dictated by overdoing between narrow limits. The committee on this vital topic worked out a consensus of actual schedules which allowed 7,450 to 8,100 "hours" for twenty-seven subjects, including language, mathematics, the physical sciences and seven differentiated lines of engineering. From this they prepared an essential curriculum, grouping preparatory studies and engineering subjects into four parallel columns, respectively, for civil, mechanical, mining and electrical engineers. This was for the usual four-years' course. But if requirements for admission are relaxed to the extent of half a year, as just suggested, some four-year courses, as now arranged, must be curtailed at various points.

Hence many raise the point that four years is quite insufficient to fulfill a broad enough program of culture studies and the ideal requirements for graduation. Consequently a growing interest in the five-year or six-year curriculum. The experience of the speaker for more than thirty years has been with a two-year program of studies and practice exclusively in the line of civil engineering, but preceded at first by four years of preparatory work in college, and reduced, during the last fifteen years, to *three* years of collegiate work in language and science, including two years of graphics. The five-year course is about as long as the young man of average financial resources can undertake, and too long for many, who then resort to an intermediate year of actual practice, which always brings more than financial return to the student in better appreciation of his studies. This question is still under discussion. Professor Perry, of London, has said, recently, in correspondence: "May I suggest that you Americans are trying to do too much at college? You are trying to teach *everything* at an engineering college. It seems to me that a college ought to teach a man how to go on educating himself after he leaves college. If this is the aim of a college, then a five or six-years' course is all too long."

But the University of Michigan has recently announced a six-year course, with three degrees in sequence: Bachelor of Science, Bachelor of Engineering and Master of Engineering.

And Harvard University, within a few weeks, has ceased to debate the question by separating

her engineering school entirely from the collegiate or undergraduate courses, and making it distinctively a graduate school. Harvard thus tardily recognizes engineering as a profession, on an equality with law, medicine and theology. The fact of such equality has long been evident enough. The practicians in the art of engineering have long levied tribute from widely diverse fields of scientific inquiry. They have profited from the labors of the mathematicians, from the Bernonillis, Descartes, St. Venant, etc., to the engineer-mathematician Rankins and his followers; only they have discarded mathematical abstractions and made mathematics available as a working tool. The engineers have directed the researches of chemists, matellurgists and biologists to useful ends in the operation of waterworks, works of sanitation, rail-making, etc. They have made chemical and bacteriological laboratories a necessary adjunct in various works. A civil engineer vindicated the veracity of Herodotus (discredited by some scholars) by making actual survey of and identifying the margin of the (so-called mythical) lake Mœris, and revealing to the modern world the vast irrigation system of ancient Egypt, thus showing how the British administration of to-day has singular analogy to the policy of Prime Minister Joseph in the control of the irrigation by the Government. A civil engineer of to-day rescued the manuscript of Frontinus from neglect by the scholars, and introduced that capable and painstaking water commissioner of ancient Rome to the acquaintance of his confreres younger by nineteen centuries. This vocation, which thus derives both *interest* and *culture* with *utility* from so wide a range of science, archaeology and classic literature, is this anything less than a profession?

Many other subjects have received the serious and constant attention of the society in the endeavor to establish practicable ideals. Among them are: Instruction by non-resident lecturers and abuse of the method by lectures; disproportion between laboratory or shop work and classroom instruction; mixing of preparatory subjects and those of the proper engineering program; waste of time by too much vacation; more work with the individual directly, rather than so much with the class as a whole; instruction in the biography and history of the profession; research laboratories and investigational work by engineering schools; the teaching of mathematics for engineering students; same as to rational and experimental mechanics and physics; engineering jurisprudence; relation of philosophy to engineering instruction; training for leadership; ought the instructors to engage in professional work? and many other topics relating to details of class work, text-books, methods, etc.

The mere mention of so many and such diverse questions of common interest shows the scope of our theme only in part. The relations of engineering schools to polytechnic industrial education are worthy of passing notice. The United States Commissioner of Education reported, in 1907, more than one hundred State universities, State colleges, institutes of technology, etc., having an attendance of 33,000 male students classified as studying technology, applied science and engineering. This includes some State colleges of agriculture and mechanic arts which might be termed semi-professional schools, as well as some of the technical institutes. Some are yet in their infancy; resources, environment, clientele and other conditions are widely different. One has been inaugurated in an adjoining State within a month. These and the trade schools, or secondary schools, which distinctively give *training* for particular occupations, are generally fulfilling their purpose.

The late Prof. J. B. Johnson called attention to the monotechnic schools of Germany, which are supported by the state or by the municipalities, and have fine buildings and complete equipment of every appliance needed to prosecute each its appropriate industry; also, to the hundreds of special schools, supported by trades and associa-

tions, which have abolished apprenticeship, and have thoroughly applied science to give exact training, with the result that the superiority of Germany in commerce, based on the growth of her great industries, has been achieved almost in a generation. The three years of study in the monotechnic schools follow two years in secondary scientific schools (*i. e.,* to include sophomore year in our grading), so that the five years produce scientifically-trained *directors* of *industrial enterprises.* Again, the commercial colleges of France, Belgium and Germany are training men qualified by their special education to invade every quarter of the globe as commercial agents and builders of industries.

In the United States, the recent Nelson amendment to the Morrill Acts of 1862 and 1890 gives increased national aid for the extension and betterment of the work of the State colleges of agriculture and the mechanic arts. Several of the States are also giving increased aid, and the State of Illinois has taken the unprecedented action of appropriating $50,000 for the graduate department of its university. The latest movement of a national scope was presented in the Davis Bill before the House Committee on Agriculture of the Sixtieth Congress. This proposed, among other things, to provide an appropriation for agricultural and industrial instruction in secondary schools. It is open to question whether the general Government is not already overburdened by its generous annuities to the State colleges, and whether the action now proposed does not more properly belong to the States themselves; whether it is not too much national interference in State education.

This brief survey of abundant and diverse opportunities for various education presents an apparently ideal situation—manual training and domestic economy for immediate industrial use, through grades of the semi-professional to the highest type of technology. Yet many point to the results as entirely disappointing.

Only a few days ago was heard a scathing indictment of the State universities by a prominent manufacturer and large employer of labor in one great interocean metropolis. He advised the States to go out of the "higher education" business and send the boys back to their homes to help support the family, instead of being a heavy expense. He is reported as saying: "Instead of teaching young men to seek labor they cause them to despise it, and the students leave the schools with the feeling that they are too good to work and smart enough to make their living by their wits."

This is an extreme view of a so-called "self-made" and self-educated man. Now your true self-made man is not be described by the jibe of the cynic, as "one who quit work when half done and then began to brag of the job." Rather are they men of hard sense who have achieved wealth and influence in spite of deprivations; and they compel a respectful hearing. While the very hostile attitude just noted is unreasonable, yet when we compare the number of leaders in large industries, finance and legislation, who lacked early advantages, with the tens of thousands who have had and now have almost a superfluity of opportunities, we have to confess that results are not proportionate to the means provided.

Professor Johnson, in arguing for a higher and better industrial education, compared the German system with the great diversity of endeavor in American education as follows:

"The common schools give no special preparation for any kind of employment; the manual training schools likewise fit for nothing in particular; our engineering schools fit for very narrow lines of professional employment, and commonly educate men away from the industrial pursuits rather than toward them; and, as for our so-called commercial colleges, what do they teach beyond arithmetic, bookkeeping, stenography and typewriting? Where, then, does the specific scientific training for the manufacturing and commercial industries come in? I submit that it

does not come in at all; that our factories and business houses are largely managed by men of little or no scientific training; who have learned their crafts in the traditional way; who are, however, of an inventive turn of mind, and who read the trade journals. They are a great credit to the system that has produced them, and many of them have become self-educated into an excellent state of efficiency; but as a class they are far from the ideal directors of such business, and very far indeed from the standard already achieved in Germany. Their success can in most cases be attributed to the extraordinary conditions offered by a new and rapidly-developing country rather than to any superior ability on their part.*

The president of another Eastern university has been quoted as saying: "Men go to college now for association and sentiment. It is a four-years' playground." There may be some reference here to the obtrusive intercollegiate contests. On the *unpublished* college calendar the usual sequence is: Football, basketball, dramatic performances, glee-club exhibitions, spring track meets for athletics, junior promenade and various festivities, baseball, boat racing and, lately, in the North, polo. This "traveling show business," in the name of institutions which stand for the highest learning and culture, has the concomitants of notorious betting and the expenditure of thousands of dollars in the traveling expenses of the loyal college "cheering squads." Thus the advantages of sports, allowable in moderation, are lost in wild extremes; thus these distractions from the legitimate work are constant throughout the year; thus some seem to regard this as their chief interest and make a business of play. We have the authentic reminiscence of a graduate of a leading New England university, who remarked at a class reunion: "We would have had a really glorious time here, if it hadn't been for those studies." This is no joke. In another college a professor found, on investigation, that the extraneous activities, such as society matters, college paper, and the various sports and recreations, most of them quite proper and even helpful in their place, might easily absorb all of the time, so as to exclude the real work of the college.

However, we recognize a minority of students who hold aloof from this, in good degree, attend to their proper business, and save the scholarship of the institution. Blessed is the man who has no money for such dissipation; he is not as poor as he thinks he is. It is noteworthy, however, that students of technology are much less affected by this evil; from many institutes it is entirely absent; and the speaker may add that all who come under his jurisdiction have to renounce all connection with that sort of thing.

This looks like a strong case for the critics of higher education. But they overlook the fact that some of the most generous contributors to the cause of higher education have been and are of those who lacked its advantages. Moreover, they fail to notice that this regretable degeneration of college ideals is more especially among those who, if they have a definite aim, will say it is "general culture," or the uplift of what they term "college life." On the other hand, the representatives of technical education enter a plea of "not guilty," for they can show that schools of technology have saved and will save the situation, in good degree. Do they not supply definite aims and a vital interest in college work? It is a platitude that the example of the technical schools has revolutionized the program of the older colleges within a generation; and that their students are prompted to strenuous endeavor, such as is unusual among students in the general courses. Indeed, one college president has commonly said to young men about to enter the engineering courses that they are expected to do about a third more work than the other students.

Nevertheless, as we have already noticed, there is much questioning of results in and among

* Proc. Soc. for Promotion of Eng. Education, Vol. VI, p. 27.

the engineering schools, and doubtless plenty of room for improvement. Each institution has its peculiar situation and its own problem. The individuality, determined by past history, traditions, resources, equipment, specific aims, personnel of the instructors, and acquired momentum must persist. We can not entirely harmonize ideals or secure uniformity in results. But all schools and their teachers may share in certain practicable ideals and some possible results which we may term *characteristics* of the best technical education.

In this aspect of our subject we may premise a broader definition, to-wit: *Technical education is a course of instruction (including suitable training) which will best prepare a man to adjust himself to his future opportunities in technical pursuits.* Usually the man can not chose as he would; only a few find ideal opportunities after graduation. Most men do not find themselves until they face the responsibilities of their vocation, especially the bread-and-butter problem. Hence the unwisdom of trying to make choices (or elect) too closely within the jurisdiction of the school. There should be, above all, a readiness to face the *vicissitudes of choice* afterward.

A *first* and indispensable *characteristic* is *thoroughness.* "Whatever is worth doing at all is worth doing well." If you say, this is an admitted maxim of life in any business, we reply that it is *systematically* violated in the whole range of American education, from the bottom up. There is woful lack of sanity in overdoing the schooling all along the line, and too little thoroughness anywhere.

We develop this characteristic by living up to certain principles of action. Among these we specify (*a*): *A man must check his work.* Here is a marked contrast to some literary training. It is not enough for the man to *suppose* results to be right, when he hands them in; he must *know* that they are right. In leveling, he must close on his benches within the allowed limit of error; in other surveys, he must close his circuits; in the shop, every piece of his work must pass the tests of the gauges. In the draughting room, every computation must be proved by himself or another, and every drawing verified by methods which he can apply for himself, so that he can confidently invite any scrutiny. Such training makes the man sure of himself and develops the sense of personal responsibility. This is so elementary as almost to need no statement, yet right here has been much complaint from the practicians. They say that in the attempt to cover too much ground, the schools do not teach the men to do their work well; that the young graduate makes many mistakes; that he does not check his results; that he does not keep a neat note book or have care enough to take sufficiently complete notes; that he is not sure of himself in use of instruments, and can not be trusted to go ahead without supervision. There is no excuse for this. Such fundamental training is the business of the school; whatever else is done, this must not be left undone.

As a case in point, a young man, out of college for an intermediate year of practice, was ordered to run a line of levels. He declined to use the instrument given him, saying that he had tried to adjust it and found an inherent defect which would vitiate his work; and, as it was a line 125 miles long, in bad country, he could not be responsible for correct results. He was commended for his discretion, given a better instrument, completed the task, and before the end of the year was made assistant engineer with an office in a railroad center. You will say that this is only ordinary caution. True; but many fail at such a point. Others had heedlessly used that instrument without proving it, probably on the assumption that a level is a level, and must do the work in some way. Again, a young graduate on the reclamation service was marked for enforced vacation, when the contractors failed and work was curtailed. But his chief said, "No, I want to keep him; somehow he always gets results and has them right."

As tending to thoroughness also we may state as *Principle (b):* "Do not have too many irons in the fire at once." For the average man in a professional course, about two subjects, followed collaterally, are enough to engage all of his interest and enthusiasm. This does not rule out one other for culture or relaxation, but that should be according to his own preference and at odd times. Any overburden tends to produce distraction and mental worry, which impair the average accomplishment. Dispersion of the stream in an alluvial channel makes shoal water; concentration makes deep water.

Working on this principle of concentration along two lines secures better *continuity* and more *sustained interest* in a given subject; also, it makes more feasible the policy of *individual instruction,* by not restricting the sessions in class room or laboratory to a set period of minutes or hours. The speaker has used for many years the half-day as a unit period, whether the assignments are for recitation, field work of laboratory.

In this principle, also, is included the necessity of judiciously excluding all non-essentials. The body of engineering literature is now so overwhelming in its quantity and range that the most diligent student can only get a glimpse of it; but he can learn to use the indexes and make his own card catalogue through required reports on assigned topics; also, how to unlock the storehouse; how to make his knowledge and elementary skill effective in emergencies.

We have noticed how largely the engineering profession utilizes the results of a wide range of scientific investigation. This gives apparent complexity; hence the division into the several recognized branches. Yet it is no contradiction to assert that a *second characteristic* of engineering education is the domination of a comparatively few controlling principles and methods.

If the members of the graduating class will take a retrospect of their entire four-years' course they may be surprised to find how much it can be boiled down to a not very large residuum of fundamental principles and data. In the applications of mathematics the really important subjects of engineering employ chiefly the more simple rules, methods and formulæ of arithmetic, algebra, geometry (including the analytical), trigonometry and calculus. The more intricate formulæ and the higher theorems are not extensively used even in mechanics of materials, theory of framed structures and hydraulics. The interesting applications of the theory of the higher plane curves in mechanism and machine design are almost the poetry of mathematics. The entire science and method of the graphic statics is plain application of such simple mechanics as the "polygon of forces" and theorems of moments; and these again are elementary propositions of geometry concerning parallelograms and laws of similar triangles.

Engineering instruction in all the leading institutions is usually differentiated into parallel courses only after the first, second or third half-year, because they all stand on this common substructure of correct theory deduced from mathematical and physical laws. In the usual divisions, or branches, such as concrete construction, bridges, buildings and arches, municipal engineering (including pavements and streets, sewerage and sanitation, water supply, etc.), thermodynamics and heat engines, electrical engineering, etc., each includes a body of special data and detail which may be studied by the student in some essential points, but can only be fully appreciated as applied by the practitioner. The speaker would urge that in the attempt to spread over so wide a range we may get too far away from our base; he would impress upon the student the ultimate unity and simplicity of the science and art of engineering in the large.

A hydraulic engineer of large practice in mill construction and power development says he is constantly reviewing his mechanics and other fundamental theory, so as to have always at instant command the principles which must be his

guide to safe practice. Another, a successful inventor and mechanical engineer, says it has been his habit to read from one to two hours daily in physics, chemistry and electrotechnics, that he may keep posted, and work correctly in his laboratory. His fine library indicates scholarship and culture.

Enough said. We leave it to the student to take some simple principles like the theorems of moments, the law of the parabola or the principle of hydrostatic pressure and trace them in their various applications throughout the range of engineering practice. The practicians are ever urging us to stick to the main principles.

Other characteristics of the broad technical education might be specified, but we must pass on to consider what, by reasonable expectation, should be the *characteristics of the student graduate*,—the product.

If we ask the officials of the schools, they would doubtless be nearly unanimous in claiming a rather good article. Some years ago the recent graduates of a college of mechanical engineering were recommended to the United States Government as competent to step in at once and operate the engines of the war vessels. If we ask the young men themselves —?

"Men are born as ignorant as they ever were"; but, looking back forty years, we see vastly increased facilities for the earnest student of today; spacious and convenient buildings, well-equipped shops and laboratories and expansion of class work and practice courses. Also, in many institutions, the benefit of the advanced policy by which leading instructors are or have been practicing engineers. Yet the conditions of the school must ever be artificial, at least in part, since they can not supply the acute sense of responsibility which goads a man on the works under an exacting chief.

What, then, are the practicable characteristics which we can specify for our graduate (if he will not speak for himself)?

He may be a competent instrument man in all ordinary surveying operations, fitted to become a surveyor after due experience.

He may be a careful and accurate draftsman, immediately available in the office, but not content to remain a mere draftsman many years.

If he is an exceptional man, with the right personal equation, he may be an acceptable inspector on works, but this usually requires some previous experience with men and affairs.

As a possible assistant to a city engineer he may have to act in either or all of these capacities during the first season.

He may be competent to take subordinate responsibilities as mechanical or electrical engineer or foreman.

In railroad work he must usually begin low down, but, with a fair chance, will win rapid promotion.

Whether in these or other openings, if he is wise, he will consider himself an humble learner, ready to take lessons from foremen and laborers, on practical details. He will avoid manifesting self-conceit and "restrain his knowledge" until it is wanted; else he may get a snub from his chief which he will remember for a lifetime.

It is another platitude that many technical graduates find their way into other pursuits for which their studies have indirectly fitted them, such as contracting, executive positions, scientific agriculture, etc.; otherwise the number of institutions and graduates would be excessive. We may say, then, that *adaptation* often is and always should be a distinguishing characteristic of the competent graduate. Unfortunately opportunities are not always ready to hand; he ought, then, to know how to "size up" the situation and go to work to make one. He may have to conduct a campaign, by interviewing, public speaking, and writing, to educate possible clients or the public, as to the value or necessity of some public improvement or private enterprise. But the engineer always labors under the odium of one who spends other people's money. Happy is he if he is where such mat-

ters are decided upon their merits. For often he will be opposed by political influence or private spite. He needs sound judgment, tact and determination to disarm opposition and push his work wisely.

Some months ago a graduate of eight years' standing wrote to the speaker that he was manager of water works, etc., in a certain town in a State south of the Ohio; that he had made the surveys and estimates, organized the company, sold the stock, built the water works, with pumping station and electric lighting station as an adjunct, and had a $50,000 plant "running finely."

Our term characteristic indicates the most important quality of all—*character*. Some cynic has said that education is but a varnish or polish; "You silver scour a pewter dish, it will be pewter still." This half-truth is so far true that our human result must depend largely upon the antecedent conditions of inherited traits or disposition and family training. The constant action and reaction between student and instructors, during four or five years, has produced professional growth. Given the right moral qualities in the man, there has been corresponding growth in character, bringing forth integrity—wholeness. In these threatening times of extravagance and corruption, incorruptible honesty in purpose and action is urgently needed. The test will come speedily, as it has to every intelligent man since Adam. If our graduate has courage to resist the tempter, even though he may lose present gain, he will surely be in demand when men "find him out." If he has enough of the love of God, he will have enough of the fear of God to put down the fear of man. Employers inquiring for graduates often say: "We don't care so much for great attainments or brilliant qualities; but we must have men whom we can absolutely trust."

In brief, the crowning characteristic is unqualified trustworthiness.

The level-headed graduate will not be misled by the familiar talk about "room at the top"; if he applies the theory of probabilities to himself, he will correct that fallacy quickly. Few have their works known and seen of all men; most of us are "unpraised and unsung." But all should have the noble discontent which ever stimulates to higher endeavor.

Rose Polytechnic Institute is working out the high ideals of its founder. It is showing its students that technical education is not the mere appropriation of a mass of information concerning theories, methods and results; but rather the selection of essential principles and data, and the co-ordination of these into a sequence of available knowledge. It reveals the accumulations of knowledge and teaches how and where to find what the man wants to know. Its practical instruction emphasizes and clinches correct theory, and makes not a present, but a possible expert. It plants the germs, arouses the appetite, supplies the working principles, and teaches men to "think it out" for themselves; each graduate is a good deal of a scientist and something of an artisan, prepared to learn something about everything, and, if he lives long enough, to learn everything about something. It is, indeed, a higher institution, a noble instrumentality in the kingdom of God; its graduates doing devoted service, with modesty and efficiency in the upbuilding of that kingdom.

Alumni

ALUMNI ASSOCIATION.

Report of the Twenty-third Annual Business Session, Thursday, June 10, 1909.

The meeting was called to order at 3 p. m. June 10, 1909, in the gymnasium, with President J. B. Aikman, '87, in the chair.

The minutes of the previous meeting were read and approved. The following report was submitted by the treasurer and approved:

To Rose Polytechnic Alumni Association:

I beg to submit herewith the following Treasurer's report:

ALUMNI FUND.

Receipts—			
Balance June 11, 1908		$307 53	
Dues for 1907-08 since last report	$43 00		
Dues for 1908-09	174 15—	217 15	
		——	$524 68
Disbursements—			
Election Committee, for 1908	$36 05		
Election Committee, for 1909	35 00—	$71 05	
Executive Committee, for 1908	17 50		
Executive Committee, for 1909	20 00—	37 50	
Secretary—			
Flowers to Mesdames Adams and Burton	$6 00		
Cigars to Mr. McGibeny	3 50		
Rose Technic, for Annual Reports	13 80		
Printing, postage, and clerk	59 46—	82 76	
Total disbursements from Alumni Fund			191 31
Balance on hand in Alumni Fund			$333 37

BANQUET FUND.

Receipts—		
Balance on hand June, 1908	$5 85	
Cash at the banquet	280 00—	$285 85
Disbursements—		
J. N. Wohnhart	$187 50	
Cigars and wine	35 00	
Menus	15 00	
Flowers and janitor	11 55	
Music	9 50	
Expressage	80—	259 35
Balance on hand in Banquet Fund		$26 50

LOAN FUND.

Receipts—		
Balance on hand June, 1908	$605 85	
Interest to May, 1909	24 40—	$630 25
Disbursements—		
Loan No. 1	$270 00	
Loan No. 2	75 00—	345 00
Balance on hand in Loan Fund		$285 25

TECHNIC SUBSCRIPTIONS.

Receipts and disbursements $69 00

MEMORIAL FUND.

Receipts and disbursements $2 50

GRAY LIBRARY FUND.

Subscriptions to date $28 00

FUNDS ON HAND.

In Indiana National Bank	$37 72	
In Indiana Trust Company at interest	630 25	
Cash	5 15	
Total on hand		$673 12

The Loan Fund Committee reported that, during the last year, two loans have been made

amounting to $345, leaving a balance of $285.25 in the fund.

The sentiment was unanimous that the work of the committee should be continued, and Mr. Galloway, '89, presented the following motion:

> "*Resolved,* That the secretary be authorized to prepare a detailed statement of the reason for and character of the loan fund, explaining fully the work which has already been done and the opportunity for further work, and coupling with the explanation a request to each alumnus for further aid in order to increase the fund to at least $5,000."

The motion was seconded by Mr. Peddle, '88, and carried without a dissenting voice.

The Alumni Advisory Committee reported that, in addition to several letter meetings, a meeting of practically the entire committee was held at the Institute Wednesday, June 9, 1909, representatives from the Indianapolis, St. Louis, Louisville, Cleveland, Terre Haute and Pittsburg groups being present. The order of retirement of the present committee was decided by lot as follows: Indianapolis, Chicago, Louisville, St. Louis, Cleveland, Pittsburg, New York and Terre Haute.

The committee reported that it had been unable to consider, as thoroughly as it desired, several recommendations that had been made, and thereupon, upon motion of Mr. Hatch, '06, seconded by Mr. Layman, '92, the committee was instructed to proceed with its work and prepare and send to each alumnus a progress report.

Among other suggestions of the Advisory Committee were the following:

1. That chapters of the various engineering societies be organized at the Institute.

2. That an instructor or senior student should be engaged as press agent to keep the Institute prominently before the public, by means of news items in the daily papers.

3. That more of the alumni follow the example of Mr. Krieger, '03, who proposes to prepare and present to the Institute a complete set of blue prints and specification of the installation of pumping machinery in the plant of the Louisville Water Company.

4. That the Alumni Association take up and actively prosecute a scheme for increasing the working funds of the Institute.

The report of the Advisory Committee shows that the committee is composed of men who are keenly alive and possess a proper appreciation of the possibilities of work by the committee.

The secretary, as retiring alumni representative, reported orally that the relationship between the Board and the Alumni representatives had been most cordial, and that, while no particular thing could be pointed out as having been the result of the Alumni representatives, yet, nevertheless, it was believed that the representation had been beneficial both to the Institute and to the Association.

The Election Committee reported that votes for Alumni representatives had been scattered among fifty-five men, those receiving the highest number of votes being Arthur M. Hood, '93, and Omar C. Mewhinney, '91. The result of the final ballot for Alumni representative was Hood, 172, and Mewhinney, 100, so that the present secretary will continue to serve as representative for the next two years.

For president and vice president the vote was as follows:

O. C. Mewhinney, '91, 64.
O. E. McMeans, '96, 58.
H. W. Palmer, '03, 44.
G. M. Davis, '88, 38.
L. A. Touzalin, '04, 29.
H. H. Schwartz, '01, 21.
F. H. Froelich, '99, 14.

Whereupon Mr. Mewhinney was declared elected president and Mr. McMeans vice president.

After general discussion the Classes of '90, '91, '92 and '93 were commended for their proposal to erect a permanent bronze tablet memorial to Dr. Mendenhall.

Members of the other classes who had the

benefit of instruction and advice from Dr. Mendenhall, while he was president of the Institute, were very insistent that they should be given an opportunity to contribute, and that the proposed memorial take such a form as to show that it was the joint offering of all those classes.

Upon motion of Mr. Layman, '92, seconded by Mr. Larson, '00, the following resolution was introduced and carried:

> "*Resolved,* That this meeting very cordially indorses the voluntary movement started by the New York Rose Tech Club for the alumni to acquire the library of Dr. Thomas Gray and present the same to the Institute; that the secretary be and is hereby instructed to take charge of the subscriptions to this voluntary fund, and that the secretary, together with the alumni representatives on the Board, constitute a committee to coöperate with the library committee of the Board in suitably placing and marking the books for the general library."

Upon motion of Mr. Kessler, '97, seconded by Mr. Foltz, '86, the Executive Committee was instructed to prepare, and present to Mrs. Gray, proper resolutions relative to the death of Dr. Gray. The membership, as a whole, displayed a great love for Dr. Gray and a keen sense of loss.

Upon motion of Mr. Mendenhall, '94, seconded by Mr. Hammond, '89, the following resolution was carried unanimously:

> "*Resolved,* That the Association expresses to Mr. H. St. Clair Putnam its regret that he was himself unable to be present to deliver the Alumni address, and expresses its thanks for his kindness in preparing the same, and its appreciation of its exceptional and satisfactory character."

The following Executive Committee was nominated and elected: H. W. Foltz, '86; J. B. Peddle, '88; Carl Wischmeyer, '06.

Nominations for president and vice president, to be voted on at the next annual meeting, were as follows: W. B. Wiley, '89; Harry A. Schwartz, '01; S. S. Wales, '91; J. J. Kessler, '97; W. A. Layman, '92; C. E. Mendenhall, '94.

Upon motion of Mr. Carl Wischmeyer, '06, seconded by Mr. Layman, '92, the secretary was instructed to convey to Mrs. Adams, director of the Glee Club, and Mr. McGibeny, director of the orchestra, the thanks of the Association for their services to the organizations with which they are connected, accompanying the same with a suitable token of appreciation. The secretary was also instructed to convey to Mrs. Burton the thanks of the Association for her services to the Association during the past year, and to accompany the same with a suitable token of remembrance.

Upon roll call the following men were found to be present:

Class of '86—Foltz, Masterson, Scott.

Class of '87—Aikman.

Class of '88—Davis, Peddle.

Class of '89—Galloway, Hammond, Hendricks, Roberts, Wiley.

Class of '91—McCormick, Mewhinney, Wales.

Class of '92—Layman.

Class of '93—Hood, Johonnott.

Class of '94—Andrews, Blinks, Hedden, Mendenhall.

Class of '95—Craver, Darst.

Class of '97—Arn, Kessler, Shaver.

Class of '00—Larson, Richardson.

Class of '01—Hammel, Miller, Piper, Riggs, Schwartz.

Class of '02—Cox.

Class of '03—Blair, Fisher, Wiedemann.

Class of '05—Bland, Everson, Hanley, Kadel, Klenk, Reed.

Class of '06—Butler, Hatch, Johnson. Kelsall, Lawton, Modesitt, Peck, Pote, Carl Wischmeyer, H. W. Wischmeyer.

Class of '07—Hall, Post, Schuchardt, H. M. Shickel, Trueblood.

Class of '08—Bernhardt, Fischer, Hathaway, Stock, Toulson.

Class of '09—Brannon, Brennan, Darst, Douthett, Frisz, Garrigus, Grammer, Isenberg, McWilliams, Maddex, Piper, Ralston, Rockwood, Smith, Tyler, Wanner, Wickersham, Woody.

Upon motion of Mr. Hatch, '06, seconded by Mr. Wiley, '89, the Class of '09 was admitted to membership of the Association, whereupon the meeting adjourned.

ALUMNI BANQUET.

The twenty-third annual banquet was held at the Terre Haute House at 8:45 p. m., June 10, 1909.

Contrary to the usual custom separate tables were used, so that the men gathered in groups of eight.

The president, Mr. Aikman, presided, and the following were guests of the Association: Dr. L. C. Monin, Dean of the Armour Institute of Technology and speaker at the commencement exercises; W. C. Ball and George M. Crane, of the Board of Managers; Dr. Mees, Professors Wickersham, Willmarth, White, Hathaway, Wagner, Bennett, Barnes and Prof. Austin M. Patterson, of the University of Illinois. Also, Mr. J. M. Howey, of the Terre Haute Tribune, and Charles T. Jewett, of the Terre Haute Star.

The Alumni present were as follows:

Benjamin McKeen, '85.
Herbert Foltz, '86.
W. C. Masterson, '86.
Charles E. Scott, '86.
J. B. Aikman, '87.
George M. Davis, '88.
John B. Peddle, '88.
W. R. McKeen, Jr., '89.
D. M. Roberts, '89.
W. B. Wiley, '89.
V. K. Hendricks, '89.
A. J. Hammond, '89.
J. D. Galloway, '89.
Omar C. Mewhinney, 91.
R. L. McCormick, '91.
W. H. Harris, '91.
W. A. Layman, '92.
Arthur M. Hood, '93.
E. S. Johonnott, '93.
M. C. Andrews, '94.
F. F. Hildreth, '94.
J. S. Royse, '94.
O. R. Hedden, '94.
W. M. Blinks, '94.
C. E. Mendenhall, '94.
E. A. Darst, '95.
Harrison Craver, '95.
A. G. Shaver, '97.
J. J. Kessler, '97.
H. G. Kitredge, '99.
H. S. Richardson, '00.
C. J. Larson, '00.
Robert N. Miller, '01.
J. R. Riggs, '01.
Max J. Hammel, '01.
R. K. Rochester, '01.
H. E. Wiedemann, '03.
M. W. Blair, '03.
J. A. Cushman, '03.
C. D. Fischer, Jr., '03.
R. C. Everson, '05.
L. W. Klenk, '05.
J. O. Bland, '05.
M. R. Reed, '05.
L. A. Snider, '05.
H. R. Kadel, '05.
W. S. Stanley, '05.
H. McComb, '06.
J. M. Johnson, '06.
Carl Wischmeyer, '06.
C. A. Kelsall, '06.
H. W. Wischmeyer, '06.
Fred N. Hatch, '06.
C. M. Lawton, '06.
J. R. Curry, '06.
F. W. Pote, '06.
E. S. Butler, '06.

C. W. Post, '07.
C. N. Trueblood, '07.
Schuler P. Hall, '07.
R. J. Schuchardt, '07.
Chas. N. Lammers, '08.
F. H. Reiss, '08.
Emil J. Fischer, '08.
W. Toulson, '08.
J. E. Bernhardt, '08.
Orion L. Stock, '08.
Amos D. Pritchard, '09.
E. W. Klatte, '09.
George E. Markley, '09.
W. H. Rockwood, '09.
C. L. Douthett, '09.
H. E. Harkness, '09.
Roy F. Tyler, '09.
E. W. Piper, '09.
T. L. Lee, Jr., '09.
H. D. Mosby, '09.
Harold Isenberg, '09.
Guy V. Woody, '09.
W. R. Maddex, '09.
Walter H. Garrigus, '09.
Chas. J. Reilly, '09.
R. L. Smith, '09.
Fred C. Kruger, '09.
Rolla S. Wilson, '09.
Robert J. Wickersham, '09.
H. Wayne Curry, '09.
Edward M. Brennan, '09.
J. M. Darst, '09.
Edmund T. Buckley, '09.
Frank W. Armstrong, '09.
Ivan R. Ralston, '09.
Glenn M. Curry, '09.
Bernard O'Brien, '09.
Harry H. Hummel, '09.
Frank K. Wanner, '09.
Fred J. Frisz, '09.
E. G. Jones, '09.
John C. Johnson, '09.

THE DINNER.

"I will never stick at the name or the color, if it be grateful to the palate."—*Montaigne.*

Little-neck Clams.
Tomato Buillon, en tasse.
Radishes. Wafers. Pickles.
Baked Blue Fish, Italienne.
Potatoes Natural. Sherry.
Fillet of Beef. Mushrooms.
Fresh Asparagus.
Mashed Potatoes. Claret.
Punch Romaine.
Lettuce and Tomato Salad.
Ice Cream and Strawberries.
Assorted Cake.
Coffee.

The menu was arranged in the form of a long-distance, trans-continental, non-transferable transportation ticket.

Under the inspiration of "Under a Spreading Chestnut Tree the Village Smithy Stands," the toastmaster, Mr. Aikman, proceeded to "knock" with considerable ability, and called upon the following for responses to the formal toasts:

"Naughty Nine."

Alone, alone — all, all alone!
Alone on a wide, wide sea.—*Coleridge.*

Richard L. Smith.

"The Faculty."

But still his tongue ran on, the less of weight it bore, with greater ease.—*Butler.*

Frank C. Wagner.

"The Road to Yesterday."

Backward, turn backward, O Time, in your flight!
Make me a child again, just for to-night!
—*Elizabeth Allen.*

William R. McKeen, Jr.

"The Future of Rose."

If to do were as easy as to know what were good to do, chapels had been churches, and poor men's cottages princes' palaces.—*Merchant of Venice.*

William C. Ball.

"The Quitter."

Our doubts are traitors, and make us lose the good we oft might win, by fearing to attempt.—*Measure for Measure.*

Robert N. Miller.

"Shearing Stresses."

Many go out for wool and come home shorn themselves.—*Montaigne.*

W. Arnold Layman.

"Taps."

So comes a reckoning when the banquet's o'er—
The dreadful reckoning, and men smile no more.
—*John Gay.*

Harry R. Kadel.

Dr. Monin was also called upon and responded in his usual delightful manner.

Others were called upon to respond informally, among them being Professor Wickersham, who had not been present at our banquets for a number of years. Professor Wickersham is the only member of the faculty who has been with the Institute since its organization, and it was a great pleasure to have him present.

Following the example of the preceding banquets this banquet was unquestionably "the best ever."

ALUMNI NOTES.

Owing to the illness of Mr. H. St. Clair Putnam, who was to have delivered the Alumni address at commencement, Mr. Arthur M. Hood, '93, was prevailed upon to read the speech in his stead.

The Chicago Rose Tech Club held a dinner at the Chicago Engineers' Club Rooms, May 14, at 6:30 p.m., with twenty-four members present. It was decided at this meeting to have similar meetings three times a year. The officers of the Chicago club are: Wm. F. Freudenreich, President; C. L. Post, Secretary and Treasurer; C. H. Fry, E. L. Jones, Roy W. Hill, Executive Committee. As we notify only those members of Rose Alumni in Chicago and vicinity, we wish to extend an invitation to all members of Rose Alumni to our meetings, and will, if possible, arrange meetings in advance, so as to notify everybody through the columns of The Technic

INDEX TO VOLUME XVIII

REVIEWS.

ROSE LEAVES.