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THE PART OF ENGINEERING
EDUCATION IN THE VOCATIONAL
WORK OF THE HIGH SCHOOL

Thesis for the Degree of M. E.
Edward G. Culver
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THESIS

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THE PART OF ENGINEERING
EDUCATION IN THE VOCATIONAL
WORK OF THE HIGH SCHOOL

THESIS

Presented to Michigan State College
of Agriculture and Applied Science.
For the Professional Degree, M. E.

by

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Bay City, Michigan.

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H.B. Dicks.*

"Engineering has been defined as 'the art and science of organizing and directing the efforts of men and of controlling the materials and forces of nature for the benefit of the human race'."

Prof. C. E. Bullinger.

THESIS

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(OUTLINE)

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OUTLINE OF THESIS

- I Engineering education as a factor in the "finding" courses of high schools.
- (1) Definition and description of "finding" course as here used.
 - a. It is a part or a phase of other courses.
 - b. The outcomes expected of such work, or what it aims to accomplish.
 - c. The present extent of this part of high school work.
 - d. Its function is to be informative as to the different lines of life work, rather than guidance.
 - e. It seeks to give opportunities for contacts and tryouts of as comprehensive and varied a nature as possible.
 - (2) "Finding" courses are to a great extent the basis for the child's final choice for a life work.
 - a. The decision as to life work at the end of the high school course is not a reserved judgement made from a summing of data. It is rather a mental attitude or tendency arrived at as a result of the experiences and contacts of the past school life.
 - b. The young person has felt his way through school. Courses, studies and contacts tend to either attract or repel in the choice of studies for the next school year.
 - c. A "finding" course is effective in proportion as it aids the pupil in this progressive choice of the different lines of school work.
 - d. Through the aid of good "finding" courses the future citizen finds himself with no reserved judgement to be made at the time of high school graduation, but instead he finds himself with

a fairly directional mental attitude, a well formulated opinion as to the general type of life work he desires.

- (3) Engineering and its allied subjects constitute a very large part of the unexplored field into which the young person must enter sooner or later inasmuch as the entire range of success that he may achieve lies, probably, in the four main branches -- engineering, agriculture, business and the so-called professions.
- (4) The field of engineering in itself is very broad, extending far and wide to merge with many lines of work formerly considered entirely separate.
 - a. To follow engineering in its entirety one would certainly have to live "long and broad" as Joseph Jefferson said in Rip Van Winkle.
 - b. It holds forth promise of happy success to many adapted ones and it should certainly be brought within the range of their "finding" course experience.
- (5) The work of engineers and the branches of engineering education being so vast and so diversified, the problem of bringing so much material and experience before the view of the high school pupils, in anything like a comprehensive manner, requires all of the agencies that we can bring to bear.
 - a. The vocational trade courses are not enough. As taught at present they give but a narrow, sad view of the great field of opportunity in engineering work.
 - b. Engineering education should also enter into and control the allied studies of physics, chemistry, and mathematics.
 - c. Engineering must color more strongly all the other branches taught, as, English, history, geography, and arithmetic.
 - d. In many schools the tail wags the dog, in that the so-called vocational classes are thought of as the extent of engineering work, instead of being a small factor only of the larger work

of engineering education in its function as a "finding" course.

- e. The personnel of the teaching force must be composed more largely of experienced graduate engineers that they may lend the influence of their advice, experience and knowledge to the total of the students experience.

II Engineering as a preparation for college work.

- (1) Preliminary discussion of engineering education, as it now exists.

- a. In the vocational department classes of high school, the junior high school and the intermediate departments.

- b. In the college preparatory courses.

- (2) The vocational courses are not at present considered as college preparatory work but rather as trade school or in other manners. They, the vocational courses, are for those who for one reason or another are not going to college.

- (3) The true and proper field for engineering education is the domination of the vocational departments in our high schools to the end that it, in cooperation with the science, mathematics and other departments, should be the accepted and usual course for preparation for engineering college work.

- a. This would provide a much needed preliminary training for the future college student in shop, drafting-room, and shop experience.

- b. There would be no need for separate classes in mathematics and science. In fact, such classes are highly undesirable. Because of the general manner of the functioning of "finding" work in preparatory schools, separation or differentiation among the pupils tends to defeat the ideal of the widest, most comprehensive experience. Moreover the pupils, will, as their tastes become more pronounced, select the phases of the courses which they most desire as the goal of their main efforts.

- (4) The establishment of the vocational department as

the recognized course leading to engineering college would serve in the very valuable capacity of sorting and cutting out in time many of the undesirable misfits who now try engineering college, instead of functioning as now as a sort of a busy work class for the hands of the mentally unfit. The vocational department, in its function of college preparation, should be a proving ground for the selection and the preliminary training of engineering college aspirants.

III Engineering education as a preparation for citizenship and the life work of the non-college man.

- (1) The supreme importance of this phase.
 - a. Here is the most important part of engineering education in the high school, a justification for the great amount of money spent by the state for buildings, equipment and teaching force.
 - b. It is in this part of the work that engineering effects by far the greater number of pupils, for the non-college class represent a large percentage of the total number of pupils in our high schools.
- (2) The needs of the non-college man, that he may most successfully fill his part to the best advantage for all, are recognized as health, and a good vocation. After these things are to be considered in the order of their importance, some sort of a hobby or avocation, as it is called, and the ability to fit in easily and efficiently with the civic, moral, and home life of the community.
- (3) Attention is called to the fact, from the above, that herein are the greatest number served and also in their greatest needs, aside possibly from the matter of health. Given a well-chosen vocation and a good avocation and we have the makings of a good, moral, upright citizen and homemaker.
- (4) Engineering education can, if properly used, go far to supply the need of the average boy who is not going to college, and furthermore this is one of the all important functions of the public high school that is at present sadly neglected.

- a. The needs of the non-college man are neglected by the present high school in that the great mass of the pupils leaving school during the 10th, 11th, and 12th grades are left, each and all of them, to find their own vocation as best they may, that is, so far as the schools are concerned. On the other hand, the entire time spent in school from the beginning to the end of the university course leading to the professions is carefully guided and paid for to a very large extent by the state. Courses are designed to fit the young for "something better". The system serves in many cases to spoil good workmen and mechanics and then fails to make them into professors.
- b. Engineering education should set up the clear objective of training in the mechanic arts for the sons of the working classes and not mince the matter. The trade classes should not be separate ones but for as large a number as possible. Trade classes should not only fill the need of the pre-college pupil and serve as a "finding" course but it should serve first of all as a real trade training class.
- c. Engineering education by enriching the academic part of the curriculum so that the pupil may gain a fair working knowledge of the things needed to be known by men in the trades and kindred occupations.

IV The head of engineering school graduates on the high school vocational teaching force.

- (1) Emphasis placed upon the lack of real attempts to teach elementary engineering in the high schools, and the probable cause.
 - a. The present high school courses are frankly preparation for the college courses leading to the professions as the law, ministry, medicine, etc.
 - b. The present vocational courses are acknowledged as supplementary to the academic courses in that they have as their objectives certain psychological aims and outcomes such as "the co-ordination of hand and eye" and "keeping the school interest alive."

- c. No serious effort is being made along the line of introducing courses in elementary engineering in the high schools. This, notwithstanding the fact that the high school is the training ground for practically all of our citizens and that a very large percentage of them will follow some trade or business closely allied at least to engineering.
 - d. There is no practical work being done to teach trades and occupations as such, to bridge the present terrible gap that is between the high school or 11th grade pupil and some useful occupation.
 - e. The high school course does not specifically attempt as it should to prepare students in an adequate manner for engineering college, neither does it attempt to select the specially fitted and adapted, and to dissuade the unfitted who are even now clogging our technical schools and lowering the standard of the profession.
 - f. The probable cause of this condition is found in the personnel of our high school faculties. They and their training are the natural result of an antiquated system, when a high school was called a "prep school". When there were in the eyes of the educational world just two classes--those who went to college and the failures who did not. Before the rise of engineering and of the present industrial age a college course meant usually an A. B. degree. The coming of this industrial age and of the engineering profession has not caused the high schools to make any serious preparation, therefore--the little effort that has been made has been for the most part thwarted and turned aside into other channels by an academically minded faculty.
- (2) Engineering school graduates could, if they would enter the vocational teaching work of our high schools, bring about a wonderful reform.
- a. They would serve to make the school system "engineering minded"; they would replace many of the present personnel who represent a training that might have been of value in a past social and industrial order but is now of little or no use in training for citizenship. Quoting from Mr. John K. Norton's summary of discussions

at the meeting of high school principals, Lansing December 1-2, 1932. "They feel there should be at least one agency in every child's life to guarantee that he will become a good citizen--not achieved by the school as now organized." Also a need for "a curriculum focused more definitely upon present problems." The academically trained and academically minded teachers who believe that the springs of good citizenship and of economic success in this day and age have their source in Latin verbs and ancient history must give place to men trained in engineering college with a first hand practical experience in some phase of modern industrial work.

- b. Reform in the school system is a matter of growth, not of tearing down and making over. The needs of the industrial training of high school pupils will be much better taken care of and the much needed changes in curriculum and in course content are going to surely come in a high school that has, for example, engineers in charge of the physics, mathematics, chemistry, drawing, athletics and trade school classes. The subjects taught in such a school are sure to take on in time less of a leaning towards the time of Cleopatra and the Renaissance and more closely approach the problems of cars, pavements, city government, plumbing, heating, health, roofing material and the fine art of being a self-supporting citizen of Michigan.

CHAPTER I

Engineering Education as a Factor in the "Finding" Courses of High Schools

The process of education is not simple. In the sense in which it is now understood, it covers all of the contacts, processes, activities, and information that produce subjective changes in the children of the school. Such a list of educational means will necessarily include all the complex effects of the child's life, not only in school, but also in the home, the church, society, and industry. Because of the fact that children under the present system of education have come to spend so large a proportion of their time in school rather than as beginners in industry, educators everywhere are striving to add to the experiences of school life such things as will prove informative in regard to the different lines of life work that may be available to the younger citizens. These efforts have resulted in the adoption of the so-called "finding" courses.

Teachers know that a young person's view of things, in general, is influenced as much, or more, by the nature of his physical surroundings as by the books he studies. From this viewpoint, a finding course may be considered as a phase, incorporated with one or more courses of study in such a way as to bring the pupil into contact with the nature of different kinds of occupations.

A finding course does not need to give direct open information about the different occupations of life. Without undue interruption of the necessary teaching of knowledge and the necessary training in habits and skills that custom and good sense appear to indicate as the correct road to good citizenship, the modern finding course seeks to give opportunities for contacts and tryouts of as comprehensive and varied a nature as possible. It does not seek to guide or advise, but rather to be informative as to the true nature of the different lines of life work by means of contact and experience.

This directed effort to aid school children in formulating an opinion of the desirability of different lines of life work has been carried on in many different ways, but is very apparent in all of our schools. The principal methods are the new and excellent illustrations in textbooks, the large number of industrial moving picture films being shown in the school auditoriums, the trips teachers make with their classes to industrial plants, and, of course, the different shop courses. The last mentioned form by far the greater part of finding course effort at present. In many of our high schools the shop courses from the seventh to the tenth grades inclusive stress the finding course idea as the main objective. In all junior and senior high school shops, the instructor has for at least one of the course objectives the finding course idea. There is another type of finding experience not mentioned above. It is harmful in effect, but, nevertheless, it leads a very large number of young people to elect some certain line of life work. I refer to the

more or less false conceptions conveyed in the histories, English texts, and other semi-fiction that is put into the pupils' hands. A few illustrations will make my point clear. A boy reads a romantic story of the brave engineer who brought in the overland mail on time and is so profoundly affected that he receives a pronounced mental set in the direction of railroad engineering. Another youth is so carried away by the exploits of the heroes of the airways that he determines to become an aircraft engineer.

A third case might be of a boy who reads in his English class an essay on one who by the simple method of shining shoes and attending night school acquires a knowledge of Spanish and German, obtains the decorations of three governments, and also becomes a famous mining engineer. Enthusiasms awakened by such tales may in some chance cases result in a happy placement of some individual in a suitable profession, but in most cases they are only will o' the wisps to lead misfits to failure.

Work in finding courses has made splendid development in the last few years. But, I conclude that the movement has very far to go if we are to see anything like an ideal condition. The contacts and experiences offered are not nearly varied and comprehensive enough. In many cases they are still untrue, and because of this fact the efforts of the professional guidance teachers who base their decisions largely on the results of the finding courses are often rendered useless and sometimes harmful.

In seeking to obtain a true conception of the needs and importance of the finding course idea and of the assist-

ance it can be to the guidance teachers, we should keep in mind that the child's final choice of a life work depends almost entirely upon the mental set that he has acquired toward the different occupations due to his school age contacts and experiences. From this it follows that the question of whether or not the adult is given a part well suited to his abilities, whether or not he is to be an economic and a social asset to the country or a misfit and a possible liability, depends upon this leaning toward certain lines of economic endeavor which he has acquired during his school years.

We come to a keener realization of the importance of finding courses and their proper development with this thought; the decision that every boy or girl must make soon after leaving school as to what his life work is to be, is not a reserved judgment based upon a conscious summing of data. It is not often made as a result of advice of friends or relatives or of graduation day orations or baccalaureate sermons; but it is, rather, the result of a mental attitude or tendency that comes from the integration of the experiences and contacts of the past school life. The young person has felt his way through school. He has been repelled by this course and attracted by that. He has admired this individual and avoided that one. Studies and contacts have served to influence his choice of new subjects for the ensuing year. This, then, was the ideal time for presenting to his mind the true facts about the requirements, advantages, and disadvantages that serve to distinguish the basically fundamental occupations one from the other; not in the form

of lectures and figures about net incomes but by means of every possible device that will make the pupil have a true knowledge, however slight, of the actualities of each main line of work, such as will enable him to either be truly attracted or repelled according to his natural tendencies and likings. This is not a very easy thing in its practical accomplishment, but it is something that must be coped with in the line of guiding and aiding the young into suitable lines of economic endeavor.

A finding course is effective in proportion as it aids and guides the pupil in this progressive choice of the different lines of school work and in the formation of a true and happy mental set at the end of the school life. Through the aid of good finding courses, truthfully presented, the future citizen will not find himself at the end of the school life with half formulated and reserved judgments to be made, but instead, he will have a fairly directional mental attitude, a well formulated opinion as to the general type of life work that he desires to follow.

The field of engineering and its allied branches constitute a very large part of the total field of opportunity open to the young man who is trying to choose a life work. In general, we can say that a young man starting in life today must make a selection of his work from agriculture, industry, business, or one of the professions as law, medicine, and the like. We may say roughly that one half of the men engaged in economic endeavor today are in one of the industries closely allied to engineering. All of our manufacturing, practically

all of our transportation, a very large part of our agriculture, our storage and canning, in fact, nearly everything that we can name of a technical or commercial nature is very closely allied to some of the main branches of engineering. And it is into this far flung and complex field that the young man today must explore his way. The profession of engineering itself has also grown to cover a very broad field. It has been extended far and wide to include many lines of work heretofore considered entirely separate. Because of the vastness of the extent of the field covered by engineering and of the occupations allied to and controlled by engineering they should certainly be brought within the scope of the very best kinds of finding courses.

That there has been a marvelous and wise development of engineering education in the United States in the last three or four decades is true. And it accounts in large measure for the splendid way in which American commercial development has kept pace with the development of Germany. It is a fact that colleges for higher education in applied science and engineering have been generously provided for and kept up. Further, the country has seen the need for so-called industrial education and is striving to provide more and more therefor. But, and this is the all important feature of the whole problem, little enough has been done by competent teachers in charge of our high schools to help the young to find their way into the proper channels that lead to this vast enterprise of engineering and industry. If we picture to ourselves the tremendous strides that

Germany has made in commerce and industry due to her intensive system of education in industry, science, and engineering, if we allow ourselves to fully comprehend that, in order to survive commercially, we, too, must strengthen and increase our industrial education, and, to an extent that some educators do not as yet dream of, then we will be shocked to find that in the matter of guidance of junior and senior high school pupils in the selection of life work, little of practical accomplishment has been done. If technical education is necessary for our national growth (and Germany has given a real demonstration of this truth), then, it is even more important that finding courses which will enable the youth of the land to find their way into those different phases of the vast work for which they have a liking, based upon true facts and contacts, should be provided.

I believe that the one greatest unsolved problem before this nation today is how to provide the means by which the great army of school children will be brought to have a real knowledge of the actualities and needs of the different kinds of work waiting for their hands to do. I believe that it is coming to be a question of whether our country is to be for the people; a country in which a wise system enables boys and girls to find their way cheerfully into work that they like, or whether the selection is to be made for the young by some all-wise psychologically trained individuals under the direction of some sort of socialist state. Whatever the answer to the above, all will agree that happy, contented people are just as much needed for a happy successful state as are "contented cows" in the dairy industry,

and the surest way to have a contented workman is to give him a job which he has chosen himself, at leisure, with open eyes, and with the truth as his guide. Our factories are not slave shops for the intelligent american workers who are there of their own choice and because they like to be there.

American industry, as I have said, holds forth promise of happy success to the adapted ones and it should certainly be brought within the range of their finding course experience, in all of its ramifications, while they are still young, unprejudiced, and have the leisure to choose.

The field of endeavor covered by the engineering profession is not only of great extent, but the kinds of work to which its members give their lives vary greatly as to type, location, and environment. Also, the educational work that is available to the student in the different technical schools is extremely varied in kind and scope; while the question of the proper line of study for the noncollege man to take up in order to reach full efficiency in the industries is difficult to answer. In view of these facts, it is necessary that educators use every possible resource at their command to give the young people of the junior and senior high schools anything like the comprehensive finding experience and information that they need in order for them to arrive at even a semblance of the truth about the nature of the different kinds of work available or of their own fitness and capacity for success therein. With a very large percentage of the professional men of the country destined within the next few years to be engaged in engineering

and technical work, and, with the full knowledge that the workmen and experts engaged in the industries allied to or controlled by engineers will amount to some fifty per cent of the people gainfully employed in the nation , educators are going to find the problem of providing the young people with finding course material that will conserve and develop the nation's latent man power along these lines in the best possible manner one of paramount importance to all educators who wish to arrive at the retirement age with an easy conscience and who have the good of the country at heart.

As I have stated, the greater part, by far, of the effort that is being put forth along the lines of finding course work at present is in the shop classes that are being conducted in the grades from the seventh to the tenth. But when I study the work being done by these classes in the Michigan high schools, I find that they are entirely inadequate in scope or in the accuracy and dependability of the experiences and the information given. As taught at present, they give but a limited, sad view of the vast needs and opportunities for success and service for the young man who will at an early age begin the work of preparation and study for any one of the lines of work available. This condition is due mainly to three causes.

The first is the great lack of accurate first-hand knowledge on the part of the shop teachers concerning the different kinds of occupations, trades, and lines of engineering practice needed by the industries and by the government or

concerning the specific types of men needed therefore, and the preparation needed for success, or concerning the exact nature of the different works as to location and environment. The second is the inherent unsuitability of the shops, as organized and maintained, to even attempt to give contacts and experiences of the varied nature needed even though a boy were to take all of the shop work offered. The third lies in the fact that the shops are used by many of the purely academic heads of our high schools as dumping grounds for every case of maladjustment and of educational misfit they may have who would not be able to get through the usual academic subjects. This results in a lowering of the scholarly standing and general ambition, outlook, and industry of the groups to an extent that precludes any chance for real contacts or experiences that will enable a serious minded boy to form accurate opinions as to the nature of the fields of industry and engineering.

These conditions in the shop courses would be improved to a marked degree if the personnel of the teaching force were more largely of graduate engineers experienced in their field in order that they might lend the influence of their attitude, advice, and knowledge to the total of the student's contact experience. It might be objected that an engineer would be narrow, and confined in his attitude and knowledge to his own line of training and experience. This, I do not believe to be true. It is the teacher's attitude and mental set as regards the branches of engineering and industry that is

needed. Also, while I hold this brief for better finding courses in high schools, I do not hope, nor do I argue for perfection in any institution dealing with human relations, and more especially with young humans. Certainly, however, the presence of trained, experienced engineers as teachers in a shop would give the young people more of an opportunity to form an opinion of whether or not their leanings were toward engineering as a work or a profession.

It must be remembered, furthermore, that while this is a discussion of the part of engineering education in the find-course work there are many other lines that must find their way into the finding course activities, lines such as pure science, medicine, business, athletics, education, accounting, selling, merchandising, home economics, and agriculture. All of these lines, and others, are and should be quite adequately represented by trained experts in each line, by men and women who in addition to their work in teacher's college and elsewhere, have had more than a little practical experience in the line or lines that they are teaching. The presence of such trained teachers should, I think, constitute one of the principal means by which the students may obtain the desirable mental set for or against any certain line of work.

It seems, then, no more than right and sensible to say that, since a very large number of the students will undoubtedly enter some form of engineering and the allied industries as a life work, a proper sorting and selection could only go forward with a considerable number of the faculty, engineer-

ing experienced, minded, and trained.

Engineering education should also enter into the allied studies of physics, chemistry, and mathematics, insofar as is needed to use these courses in the best possible way as finding courses for the engineering professions and for the industries. In order to accomplish this in the most efficient way, the first step should be to have at least one half of the teachers of these subjects graduates of engineering schools and, also, there should be a fairly large percentage of them possessed of considerable experience along some engineering line. There, on the faculty these men would simply be themselves. In addition to being the boys counselor and friend, they would be always an example of what an engineer was like. They would create the necessary atmosphere, emphasize the methods, and introduce the vocabulary and writings of the engineering world. Under their influence the library could be better supplied with engineering periodicals and the reference list of books would contain more names of elementary engineering texts and handbooks. Occasionally engineers of note could be induced to fill in at the auditorium meetings to show the pupils what they were like and to some extent, give a true picture of the nature of some well-known engineering problem in such a way as would aid the young people in forming an absolutely truthful picture of what it would be like to take part in the project. These men teachers could also enlist the aid of local engineers who would describe the building of some local road or other project in which there was a general interest.

Understand that I am not advocating making these sciences more "practical". Neither am I outlining a course in elementary engineering. I am endeavoring to show practical ways in which engineers, as teachers, can serve to aid in the working out of the great finding course problem, the problem of aiding the youth without interrupting or disrupting in any way the present program in forming a truthful picture, an accurate conception of what it would mean for him to engage in some job or profession as a life work, to the end that each individual may then choose, of his own volition, according to his own likes or dislikes.

Engineering must also color more strongly (and truthfully) such subjects as English, history, geography, and arithmetic. I have mentioned in the first part of this paper the evils that come from too dramatic and too highly colored accounts of the exploits of "exceptional" individuals when presented to English classes in an attempt to give knowledge of occupations in America. On the other hand, the English class, due largely to its nature and to the fact that eight and more semesters are devoted to the work, offers a splendid opportunity to present the truth about the different occupations. To illustrate: a boy could give as a composition a description of how his father prospects for and drills a new oil well. Under the teacher's guidance the boy himself and his paper or speech could be a splendid picture of what the work really meant. Some would be attracted and some would probably think, "I do not choose to drill for oil." If so, we would have an almost ideal finding experience, namely a

self-willed choice founded on fact, rather than upon drama and fancy. This idea of allowing the boys and girls to pose as examples or representatives of the personnel of the different occupations or professions, as they tell or read their description of the parents (or their own) duties and activities, could be carried out to include practically all of the local occupations. None of these would change the course an iota from the objective of teaching some part of the required English instruction. Almost the same amount of good could be accomplished in history and the other subjects mentioned. With, the idea of watchful supervisory care and wholehearted effort always in mind, no opportunity on the part of the teacher would be missed to present the true view, the accurate word picture of the world at work, in order that the boy or girl may be aided in longing for and finding a happy place therein. Engineers, as teachers, should and would struggle to keep the different school subjects mentioned free from the untruthful descriptive matter and also work for the type of lesson that would present the truth.

Great as is the finding course problem, in general, and whatever the means taken to solve it, I am convinced that the main way in which the good work can be started in the engineering profession approach, as well as in the approach to the industries allied thereto, is to provide an increase in the number of graduate and trained engineers on the teaching forces of our high schools. The personnel of the teaching force in our high schools, I repeat, should be composed nearly fifty per cent of engineering school graduates that they may lend the influence of

their experience, advice, and knowledge to aid the pupils in making a wise selection of a profession or occupation. If not, the next few decades will see the state technical schools, trade schools, and the profession itself along with its industries clogged with an even larger number of ill-adapted, disappointed misfits than at present.

CHAPTER II

Engineering Education as a Preparation for College Work

Before taking up a discussion of what part engineering education should play in the high school preparation for college work in engineering, we will consider briefly to what extent it now forms a part of the high school curriculum.

There are certain subjects now taught in high school that would certainly be considered as basic and fundamental preparation for any course in an engineering college, if there were any such institutions, in which the youth was entered from the grammar school without any high school preparation. I can list some of the subjects as follows: elementary mineralogy, location of engineering projects as found in geography, part of engineering law of contracts as found in business courses, mathematics, physics, and elementary mechanics. A careful study of these will lay the foundation for success even for one who intends to study alone without the aid of a college training; therefore, these subjects may be considered rightfully as being engineering preparatory subjects now being taught in the present status quo of high school affairs. The English department also has much of its work devoted to things that are, of course, absolutely needed in an engineers training.

It is in the vocational high schools and in the vocational departments of the regular high schools that we find

the only direct and segregated effort at preparatory training in engineering. Here the pupils are taught much about the materials of engineering; a considerable amount of the nomenclature becomes familiar to them; they learn a little of power transmission, both electrical and mechanical; and they begin to grasp some of the connection and correlation between design, mathematics, production, and artisanship. However, the vocational department is not at present considered as a part of the college preparatory work, but rather as a preparation for those who for one reason or another are intending to enter the trades and not go to college, and , therefore, the present status of the vocational department is such that it cannot be considered as preparatory to engineering college work.

A phase of preparatory engineering education, not often thought of, is the attempt, on the part of some of the teachers, at least, to imbue the minds of students in mathematics, physics, and chemistry with the professional spirit of engineering. This praiseworthy attitude of some teachers is meeting opposition. The idea of not allowing students preparing for engineering college to indulge themselves in the same lax study habits as do the students preparing for the academic degrees, would be good if it could be practically carried out in a general school in which the science studies have to serve a dual purpose. First, they have to serve as a sort of appreciation course of the Creator's handwork and must be developed along broadly qualitative lines. Second, they must be made to serve as a training course in the

professional attitude, a tryout of the boy's adaptability toward engineering in general, a course developed along quantitative lines. Because of the above, I find that training in the professional attitude and sure, accurate study is practically non-existent in most high schools, especially in those schools in which the doctrine of allowing the students to pursue the even tenor of their ways without interference from teachers is becoming prevalent.

In regard to the divergence of opinion existing as to the advisability of maintaining separate courses in the sciences in technical high schools or departments within the present high schools, it is my opinion that a sane middle ground of teaching in the high school science departments, coupled with the change in teacher personnel which I advocated in the first chapter would solve the problem. If the science and mathematics courses were to be taught in the time-honored style with graduate engineers composing some one half of the teaching force, all of the pupils would be able to acquire a broad fundamental training for any line of life work and at the same time receive an ideal find-course field in their science and mathematics work. Separate courses in "shop math", "engineering physics", "radio physics", "girl's physics", "practical chemistry" are not desirable from the standpoint of the finding course program as I have outlined it.

I believe that the idea of the segregation in the high school has its roots in the success of such technical schools as

Rensselaer Polytechnic Institute, Worcester Polytechnic Institute the Case School of Applied Science, the Stevens Institute of Technology, and the Massachusetts Institute of Technology. These schools have, of course, kept to almost exclusive technical lines and are independent of other colleges.

It must be remembered that what applies to college stage of development education does not apply in high school. In colleges and in beginning industry, the finding work and the sorting have been accomplished, or at least we hope they have, while the chief function of the high school both senior and junior is to serve as a finding experience, as an almost automatic sorting field. How, I ask, are we to provide pupils with the widest range of contacts, with the most comprehensive tryouts, if we begin by narrowing where we should broaden?

On the contrary, of the young who are interested enough to find their way into high school mathematics and science classes we should make no division into groups. The finding experiences can be made sufficiently numerous to suffice, and a properly taught high school science course can be made to serve as a tryout and a preparation for engineering without any disrupting of the regular system.

From the foregoing it is clear that, with the technical school busy with the more professional subjects or those subjects quite closely related thereto, a thorough preparation in language, history, literature, economics, mathematics, and science as given in the usual college preparatory course can be considered as a

direct part of engineering education. The engineer must be a broadly cultivated person and able to cope on equal footing with the men of other professions. These courses, then, being an essential part of the work of the technical school training for engineers, can, if well covered in high school, relieve the technical school of part of its burden and thus leave more time for the much needed technical training and experimentation. So much for the work of the academic high school departments in preparing boys for the engineering profession.

I have stated that the vocational department is not at present considered as a part of the college preparatory course scheme, but rather in the light of a trade school. A professor of an engineering college staff said recently that boys from the vocational departments and vocational high schools did not measure up to the standards of the university engineering courses as well as did the boys from the regular college preparatory courses. And yet, the true and proper field for preparatory engineering education is in the vocational departments of our high schools. Engineering education should enter into and dominate these departments as its own rightful field, to the end that, in cooperation with the science, mathematics, and other departments, the vocational course would be accepted as the usual one to take in preparation for college work in engineering.

I believe that, in general, if an engineer today can say truthfully that his early training, from the beginning in

fact, was planned with an eye to the profession and the division of the profession that has proved to be his life work, then he is, almost without a doubt, more than averagely successful. Such a man is happy and competent because of the years of successful experience behind him. He is a credit item in the community appraisal of man power and knowledge.

It has been noted by many observers that boys raised on farms and ranches usually made better engineers than did equally intelligent boys from the city. This is to be expected. These boys have had an opportunity to develop resourcefulness. They have handled tools, animals, combated the forces of nature in an intimate manner, much of which opportunity is denied to the average city boy. In all probability, many of the country-bred engineers from whose success the foregoing idea or belief has grown were the products of the older frontier type of life that is no longer so common. Nevertheless, self-reliance and resourcefulness are prime requisites in the qualifications for an engineer, and life on a farm would undoubtedly serve to develop any such latent qualities or would serve to discourage anyone not so equipped from further effort in the strenuous life of the engineer.

If all of the college preparatory students in engineering were to take the shop courses as they should be organized, they would receive the above enumerated types of development and tryout at the same time they received a much needed preliminary training for the future college work in

shop, drafting room, and experience with materials. The objection will at once be raised that the organization of the shop course purely as a finding course precludes any such effort. The answer is that shop courses in the senior high school should not be finding courses; that like any other course in the senior high, the dual objective should be kept clearly in mind, namely: to prepare for college work or to prepare for life without the college.

All courses in high school should have this dual objective. The finding course should, or rather the idea should, as I have said, be incorporated therewith as a phase without disrupting or interrupting the main work of the course.

Some claim that the segregation of the groups would place students in such a course in a group by themselves in physics, chemistry, mathematics, and English classes. I believe this to be wrong. In fact, such separate classes would be highly undesirable. Separation or differentiation among the pupils tends to defeat the finding course ideal which is to provide the most varied and comprehensive contacts and experiences for the largest number of pupils. As the tastes of the young become more pronounced and directional as to occupation, they will select the courses and stress the phases of those which they most desire as the goal of their main efforts. That is, pupils will by the time they reach the tenth grade either display a liking for shop work or a dislike for it. The same will be true of physics, chemistry, physical geography, mechanical

drawing. These subjects will certainly, if well taught, serve to further the development of a definite mind set of the pupil, but the course itself will be taught on the assumption that the pupils taking it are there in the class because they want to be there as a part of a presumably selfselected course. All this may seem incoherent, impossible, to some, but remember that the high school, more than college, is a time of physical and mental growth and constant change.

"A boy's will is the wind's will,

And the thoughts of youth are long, long thoughts."

We must remember that the finding process must go on continuously and progressively for the entire six years of high school life, that it is partly one of development and growth. We must not try to force the issue by demanding of the youths that they choose this road or that irrevocably. We must avoid making a boy say, as I heard a boy say this semester, "I took the drafting course but I'm sorry. O course, it is too late to change".

All high school courses, I refer to the courses of study high school has laid out, such as, college preparatory or drafting, not to separate classes, as algebra or French, must be kept as near alike as possible; times for final decisions must be put off as long as possible (the nearer graduation, the better); ways of changing from one general direction to another in occupational tendencies must be kept open; and running through all of the courses, must be the phase consisting of as many

kinds and types of finding experiences and occupational contacts as possible, or as ingenuity and professional skill can devise.

The present type of shop course as I have found it in Michigan high schools cannot fit in with this scheme for the following simple reasons: First,- There is the custom of using the vocational shops and courses as a dump to which are herded the moronics, incorrigibles, misfits, and problem cases, thus giving the shops a bad name scholastically, which, in turn, prevents the high grade mental types from electing the shop and other vocational courses. Second,- The fact that the shop courses are not so arranged that the pupils taking them can easily enter college creates the impression that they (the shop courses) are for the individuals who for reasons of financial or mental deficiency, or both, are not going to college.

Naturally boys of high mental calibre or ambition hesitate to enter them, and naturally, there has grown up an evil condition of social and money-class difference that is, by the way, out of place in state-owned democratic institutions.

This condition must be done away with to arrive at a condition that squares more with common sense. The vocational courses must be made to be the usual and recognized path for those who have a marked predilection for the industries whether with or without college. The pupils from these vocational courses must have the same place in the sun as do the other pupils in the school with the same classes in physics, mathematics, and

other subjects. The silly placing of mental failures in expensively equipped shops to play with expensive machinery because nothing else can be found for their hands to spoil must stop.

The shop course should be open to all for one semester to as many as may be found time for in the students program. Most important of all, the standard of scholarship and teacher ability should be held to a level that will be fitting in a course leading to college work in the applied sciences, home economics, and engineering. Raised to such a standard as I have outlined, the vocational courses would not only serve to aid in the preparation of high grade beginners in the skilled-worker class of which I will write in the next chapter, but will also serve to sort and cut out in time many of the undesirable misfits who now try engineering college courses.

Instead of functioning, as now, as a sort of busy work department for the hands of the mentally unfit, the vocational department in its function of college preparation should be a most valuable proving ground for the selection and preliminary training for the selection of engineering college entrants.

CHAPTER III

Engineering Education as a Preparation for Citizenship and the Life Work of the Non College Man

This thought has occurred to many teachers: Supposing that after years of training one of these boys should fail in essential ways to measure up to the standards required of men in the profession for which he is striving, does our system provide him any means of real economic usefulness with which he will feel somewhat satisfied after the training he has taken? Is there, in other words, a system of well marked stopping places along the educational road at which those who feel that they cannot for one reason or another advance further may stop off and find a good economic use for the knowledge and skills they have attained while in school?

In older times, say fifty years ago, this was certainly true. A young person finished grade school and proceeded to enter one of the many trades and occupations as a beginner or as an apprentice, although the word was passing out of use at that time. Hundreds of occupations were open to him. He would simply choose the one he had learned to like or lean toward because of personal acquaintance, contacts with working conditions, hours, and so forth. He would begin as a helper, "stay by it", and so reach a self-satisfying economic level. A second class, goaded by self ambition or the urgings of friends and family, would enter high school. Finished there,

they taught school, read law, entered banks as clerks, or "accepted positions" as bookkeepers or druggist's apprentices. A third class went on to college. They became college professors, lawyers, doctors, and "civil" or "electrical engineers".

Times have changed, society has changed, and most of all, and, this is the important part, occupations have changed, changed in number, kind, requirements, and in age of entrance. Schools have changed, but not in any sort of synchronism, phase, or motive with the changing industrial world. Boys and girls by state law in Michigan complete the tenth grade, unless they have reached the legal age limit, and all are urged to complete high school. The number who enter industry at an early age is growing smaller and smaller. The period of trade and industrial training has been dropped for most. The boys and girls go to high school instead, and prepare for college. The first exodus from school to the industries at the end of the grammar school grades has dwindled and now includes only those who are probably destined to fill the ranks of unskilled labor. The second outpouring which occurs at the end of the high school career, contains, without doubt, individuals better equipped for clerkships, business, and social life in general, than were the eighth grade graduates of the nineties. The girls still find many of the old time clerkships, as well as homemaking, open to them; the boys entering clerkships and minor office work, and those taking to farming still have much the same kind of work and the high school training seems to help.

But for the boy entering industry things are different. He no longer seeks a place in a country workshop or some small factory. The boy entering industry today goes into a highly mechanized army. Everything he meets with is engineer-planned and engineer-controlled. He finds every conceivable degree of skill and ability, reaching from such grades as factory piece worker up through the grades of surveyor, draftsman, designer, chemist, manager, and chief engineer. He looks in vain for any sharp dividing line between the classes. There will be practically every possible type of artist, artisan, and mechanic with practically every possible degree of ability represented.

This great army of men from the generals down will be engaged solely in one work, that of producing and transporting goods of every kind. In numbers they will form roughly one half of the people who do things in the country, and the vast majority of them are non college men.

Here, then, is the most important branch of engineering education. To prepare these young people who leave high school and go into some form of the industries to find their way into suitable employments for which they have natural aptitude, and to give them preliminary training that will contain elements to replace the lost apprenticeship years, would be a real justification for the great amount of money spent by the state for vocational buildings, equipment, and teaching force. It is, therefore, in this field of engineering education in the vocational schools that the greatest number of

individuals can be reached and the greatest good accomplished.

In order that a man may be a good citizen, a good home maker, and so be of the most value to himself and to others, he must have health and a vocation to which he is suited. We can visualize, I believe, the need of having each man working at the vocation to which he is best adapted and the great increase of wealth, man-power, and general contentment among the workers that would result therefrom, if we consider any project or enterprize with which we have been connected in the past as engineers and imagine all of the different assignments changed so as to put each worker at the particular part of the work to which he was least fitted. The chaos and inefficiency that would result, along with the great financial loss and probable breaking up and abandonment of the entire job, should serve to indicate to us what is going on in the engineering world at large today due to this employment everywhere of poorly prepared, untrained misfits.

Further, any engineer knows the prime importance of having all the people on a job or any undertaking supplied with some sort of hobby or avocation to keep them contented and also the importance of having them all of a type and training that will allow them to fit in well with the social and religious life of the community. These requirements, when considered as applied to the whole of industry, show the importance of these qualifications in the vast and complicated organization of national industry as a whole.

Experienced graduate engineers, as teachers, knowing the great needs of the non college man in industry and knowing, also, the need that industry and the nation have for non college men, can go a long way in improving the present condition. The objectives should always be the dual ones of preparation of some for engineering and technical school by cooperation with the mathematics and science classes and of imparting knowledge and skills of commercial value in every course taught, and of having everything possible about every course serve as true finding experiences.

The importance of having such departments in close touch with the field of modern industry is apparent. A shop class such as I am describing will of necessity be taught by an engineer with a fund of teaching and technical skill and experience. Such a teacher would need to be in close and intimate contact with the types of work and the kind of life into which his charges must find their way. The good that has been derived in the past few decades from the application of scientific and engineering methods and knowledge to the arts and manufactories with the practical applications in the hands of skilled mechanics should teach all concerned the need of the development of this knowledge and skill within the entire body of the industrial army. It is apparent that the only place to accomplish this is in the high school. That the work is a dual one of training, development, growth, and teaching, on the one hand, and choosing finding, and sorting on the other.

It is evident that the most important part of this work for industrial America has its outlet through the shop or so-called vocational classes, and that in these classes by far the most important work lies in the proper training, orientation, and guidance of the non college engineer and worker. No organization or company can long stand the stress of incompetent workers in the subordinate positions and in the shops. Failure in either or both of these things means failure and bankruptcy, either partial or complete, as the result.

What applies to a single organization applies to industry at large. The aorta, bottle neck, if you will, of the stream supplying these workers is the high school vocational department. Nothing should be too good in the way of teacher personnel for these institutions. The men I have described as needed for teaching here would cost money, but anything would be cheap as compared with the vast sum of wastage, incompetence, and inefficiency that at present is indicated in the types that plug the employment entrances and add to the overhead by incompetence in management.

As the high school curriculum, teaching force, and objectives are at present organized there is little or no thought given to the needs of the non college man. All of the courses of the departments other than the present so-called vocational department have as a clear and recognized objective, the preparation for college. Under the present system in vogue, the boys and girls who do not attend college or prepare therefor are considered as being something a little different, as being

outside of the main line of the institution's endeavor. All of this, notwithstanding the fact that only a very small percentage of the pupils entering high school ever complete the course and go through college. The greater part by far of the pupils leaving high school do not go on to any form of future study and are left to find their own vocation as best they may, at least, so far as the schools are concerned. On the other hand, the graduates who enter college receive training of a specific kind that will fit them to succeed in their chosen professions or other activities.

The reason for this condition is found in the fact that under the present system the vocational departments are tagged as being of something inferior to college grade, that the principals put into them students of subnormal capacity, misfits that the teachers have failed with, and others, thus enhancing the desirabilities of the college preparation courses in the eyes of the student body, and correspondingly degrading the desirability of the other courses.

The brightest minds both in the student body and on the faculty are engaged at present in guiding and directing the college preparatory classes. With the school's every energy bent upon the task of preparing the entire population of the country to be super men and women, to be sales-managers and executives, to make them "succeed", it is no wonder that anything like an occupation outside the so-called white-collar class should fall slightly into disrepute.

Inasmuch as a negligible few ever will or can find their way into "superman" jobs or even into "assistant superman" jobs, and because the great majority of the product of our high schools must work for a living, - that is, they will be, we hope, skillful "dirt" farmers, actual mechanics, bookkeepers, draftsmen, and other varieties of plain everyday Americans - it would be much more fitting that all the energies of the school be turned to this latter class.

The engineering profession should set up as the clear objective, at least, within the vocational classes the frank aim of training the sons and daughters of the industrial classes to have a definite and chosen occupation in the mechanic arts, not neglecting agriculture, by which they would be able to earn a livelihood; all this, of course, in addition to the general knowledge and skills usually considered as comprising an elementary education. By so doing, the engineering profession can aid in enriching the purely academic courses to the extent that all pupils may obtain a knowledge of the things to be known and the kind of life to be lived by the men in the trades and other occupations.

CHAPTER IV

The Need of Engineering School Graduates on the High School Vocational Teaching Force

The courses that exist in the present high schools of the state and the methods by which they are presented to the pupils, along with the generally prevailing educational atmosphere can be considered only as a preparation for such professions as the law, medicine, teaching, or business. Little practical training is given for engineering or the industries connected therewith. Neither do I find any evidence of any real attempt being made to introduce elementary engineering teaching into the high schools. We can arrive at this conclusion by the most cursory examination of the studies taught.

Mathematics and physics are the nearest approach we can find to beginning engineering, but in most of our schools these subjects are taught by women teachers or by men with a purely academic background and school training. There is, therefore, in these courses little of value as a pre-engineering finding subject. Practically no professional attitude could be inculcated by such courses and, as in most beginning science courses comparatively little factual knowledge is retained, the most valuable part from the standpoint of elementary engineering is lacking. Few good professional habits of investigation and thought and of record keeping are taught. On the contrary, many harmful habits of indolence, inaccuracy in calculation, and careless observation are formed.

Such classes as I have visited would possibly serve as preparation for the more carefree life of some of the liberal arts colleges, but they have little in common with the preparation for engineering training or for a strenuous competitive life in modern industry,

The English classes come the nearest to the required standards of engineering preparation classes. All engineers know that training in literature and the classics enables a man to meet as an equal the men of the other professions whom he contacts. Also, every engineer knows that accurate expression and fluent command of language are indispensable in his work. There is, however, little of the vocabulary of engineering and little of the general style and diction of the engineer in the work of the average English class.

In regard to the shop courses as they are now organized and taught, they are acknowledged as being merely supplementary to the academic courses. They have as their objectives too many psychological aims such as, for instance, the "coordination of hand and eye", or that other very laudable purpose of keeping the boys in school. Leaving aside any discussion of the general aims of these present vocational classes as to whether or not they are good as pre-engineering training, the students in these subjects in most high schools are not taking courses that lead to college. The course of study they follow does not give them, in most cases, credits enough to enter college. It is quite apparent, therefore, that

there is little or no real attempt being made to train or to give real finding course experience in those occupations, engineering and engineering industry, that will absorb a very large percentage of the high school product. Nor is any serious effort being made on the part of the academically trained teaching forces to introduce courses of study that could be called pre-engineering courses or to rearrange and rebuild any of the existing courses.

As for the causes of this condition in our schools, we can quickly point out three that, I believe, are the prime factors. All three of these could undoubtedly have been overcome or ameliorated if the vocational teacher personnel had been different. The first is the almost complete lack of agreement among educators, taxpayers, legislators, parents, and industrial men as to what constitutes the aim, the purpose, and the general method of procedure to be used in our vocational high school work. The second is the almost complete lack of professional engineering background or training among the vocational teaching force, coupled with a lack of general education of a college grade that serves to discount their influence and belittle their general standing among both pupils and teachers of the high schools.. The third is due to the fact that the superintendents, principals, department heads, and, of course, the great majority of the teachers are academically trained and minded. Their interests, their educational activities, and their activities outside of teaching

have in the great majority of cases been along the lines of the humanities, pure science, sociology, economics, education, and the like. Notwithstanding the fact that the groups enumerated above represent in their number practically one hundred per cent men and women who have a temperament, character, and training that places matters of child and community welfare above, or at least on a par, with their own, it would be improbable that these men and women should be able to see eye to eye with engineers and industrialists either the needs in engineering education or the best means of their attainment.

I will mention a few of the many incidents and conversations which I have available to illustrate this lack of unity as to aim, purpose, and method that exists, as I see it, in the vocational departments. There is nothing critical in these conversations. They are given with the one purpose of clarifying the picture as to existing conditions. Possibly the condition of misunderstanding and cross-purpose work is due not so much to anything that the shop teachers have done or have not done as it is to the antiquated system from which they derive - a system under which a high school was a state or city supported "prep" school, organized to give to all the benefits that had previously been only for the sons of the wealthy. At that time there were but two groups in a "prep" school, those who made the college grade and those who did not. Before the rise of engineering and the present industrial age, a college course usually meant the A.B. degree. The coming of the new

age has not found all school men inclined to make the necessary changes, and what changes have been achieved have been thwarted and turned aside by the more academical of the faculties.

A superintendent told me that the main purpose of the vocational, or as he called it, the manual training branch of his system, was to aid in co-ordinating mind and hand. The high school principal in the same system assured me that the main purpose of the vocational classes was to provide a means of getting those pupils through to graduation who are mentally or otherwise inferior and cannot get through the academic department work. This same principal brought a boy, the pitcher on the baseball team, to the teacher of mechanical drawing and asked if he could be taken on for an extra class in drawing, "You see he is failing in mathematics and if you can get him thru drawing, it will help a lot." After the boy had left he added this, "He is very slow and dull; maybe you can get him to making blue prints, and make a draftsman out of him."

A college professor remarked to me that one of the boys was "not so quick" and that he very likely would have to follow some sort of vocation. But said he, "This other boy is showing a mentality that will warrant something better for him." A school board member criticized the high school wood shop sharply. "Foolishness", he declared, "They spend a hundred dollars to make a toy broom holder that would not sell for ten cents." I talked with a graduate of the University. He mastered in Education. "That stuff is about all through", he declared, "You can see what

I mean, the people are fed up on it."

Again, we have the head of a high school speaking of the value of the classics as a preparation for life. He quoted from a recent book the story of a graduate of a famous English school who had taken all he could of Greek, Latin, and mathematics, and who was then placed by politics in charge of a colossal construction job in Russia. The job employed hundreds of men. His efforts due to his special training were crowned with success. As far as I could make out, it was the knowledge of human nature gleaned from the Greek, the direct and forceful diction derived from the Latin study, and the mental discipline from his years of mathematics that made him succeed where an engineer would have failed.

I have, since beginning this work, talked with many who, though having, like Luther, "small Latin and less Greek", are, for all that, important in the industrial world. Mr. A is a graduate engineer and has been chief tool designer in a large plant for some years. "What is the chief purpose of our vocational school and why is it kept up?" I asked. "It is kept up to put the boys a little further along the line of advance in their life work. The course should help the boys to become more successful laborers, or, if possible, better mechanics. If they show the natural ability it should aid them along the line of an engineering college course." I could, I am convinced, write almost a book of interviews with people who have very certain ideas as to the proper function of the vocational courses in our high schools. In all of my experience with vocational school men,

and with men and boys not in school work, I have but one clear and outstanding impression on this matter and that is this: there is an almost complete lack of agreement among these people as to what the vocational schools and the manual training departments that have been installed at such a tremendous expense are trying to accomplish. The condition is entirely chaotic so far as the purpose and aim of the vocational work is concerned.

There seems to be an almost complete lack of agreement among and between the three classes of supporters of this work. By the three classes I mean the patrons, the school men, and the lawmakers who make the appropriations for these schools. The opinions and hopes of the vocational teacher writers of text books do not agree at all. The ideas held by the school's patrons vary between great extremes, and there is little unity among the law makers as to the purpose for which they make the appropriations. The purpose stated in one founding bill for a college was, in effect, to provide training for the sons of the industrial classes in the mechanic arts. The technical high school in one city was endowed by its chief backer for the purpose of making boys into better citizens by teaching them a trade. On the other hand, the manual training department of a certain city was built up and is supported on the theory that it serves to maintain interest, so keeping the boys and girls in school, acts as a try out and a contact course to aid the children in finding their life work, and also handles the problem

pupils.

As to the patrons, the head man of a soft coal mine was very concerned about his boy's chances for a job when he would finish school, and whether or not he would be able to hold his own with the other young draftsmen with whom he would have to compete. A mother feared that her son's intense interest in his drawing work would win him away from the work she had selected for him, dentistry. And, as to the teachers, a printing teacher boasts of the large number of his boys who have followed printing as a trade. Another instructor declared that it did not in the least matter what they were doing just so long as they were contented and busy, while still another opined that it was too bad that all this interest and energy could not be directed along some educational line.

Now there is a general feeling abroad, an opposition taking head, against the spending of more money on the vocational work. Of course the determined effort to curtail school expense is general, but one views with grave concern the unity with which the ire of the retrenching taxpayers is directed at the vocational department of the high school. Practically, the talk is about doing away with vocational work; no voice seems to be raised against the academic department. The good people do not know what the vocational work is for and the members of the board cannot tell them just why they are keeping it up. The teachers themselves seem to be able to say little in its defense.

They say that a house divided against itself cannot stand. This is quite true and a ship without a rudder is helpless. But even a ship without a rudder is better off than is a ship where there are some dozen or more warring captains with an absolute zero of correlation among themselves as to little matters like course and destination. Of course if a boat is just sort of going about "contacting" other boats and things, that is all right. This, I say, is about the condition of the ship of the vocational school venture in Michigan. Let me carry the figure along. In his poem, "Gloucester Moors", Mr. Moody says,

"I watched while her captains passed,

She were better captainless."

A great movement in education, a great reform movement, has had marvelous support from the tax-payers and from the lawmakers, because it seemed to them to fill a long felt need. The move toward industrial education is being killed from within by the very people who are supposed to be its supporters, the teachers and the leaders in the movement.

As a class, the vocational teachers have been false to the trust put in them to push the new movement ahead, to broaden and direct it into the proper channels, and to agree on and clarify the statement of its purpose and objectives. Many of the teachers in this work are there because there was an opening.

As a class, the principals of our high schools have

viewed with alarm the growth of the manual training idea from a small beginning to its present great size. They have deplored the presence of a large personnel in their teaching staffs who are not academically minded. On the other hand they have realized that the new department has served to make the course they run much smoother. The schools and the graduating classes are larger as are also their own salaries, due to a sort of sympathetic rise along with the increased school interest and attendance. So torn between fear and satisfaction they have seen fit to designate academically trained senior teachers to be so-called heads of the vocational departments. We can truly say that the vocational movement is in the hands of its enemies and not its friends. If the vocational work is to stand for a vote of confidence from the taxpayers with its present teacher personnel and its present chaotic condition as to aims and purposes, it is going to be more and more a case of thumbs down on appropriations.

There are splendid men in the vocational work who are exactly fitted for it. And, there are in the vocational department splendid men who would be very successful in some other lines of work. But there is only one test of efficiency and that is the measure of effort and accomplishment. I submit that few efforts have had better support than has this movement. Money has been spent generously. Entire new buildings have been erected for its sole use. Equipment has been supplied with a lavish hand. In one high school is a woodworking outfit that greatly exceeds that which I had for use when I took my course

at Michigan State College, and all this equipment is used for for some forty pupils. The thought of the taxpayers has been, to make this thing a success and not to spoil it by being too economical. To match this great outlay I can find no unity of purpose and little of accomplishment. I conclude that the movement has not been a success and that the teachers are the cause of the failure, since they have had charge of the movement. I conclude that the present personnel is not the right one and that a change is imperative. Otherwise the movement will fall into a state of disrepute with the taxpayers that will place it beyond help.

If anyone should claim that I am guilty of false generalization in the following, let me say that even if the conditions as outlined do not obtain in all of the cities of the state, nevertheless, the fact that they do obtain in the cities investigated is ample cause for concern and ample substantiation for my premise. I am convinced as a result of having called upon the vocational departments of a very large number of the high schools in the state and of having conferred at length with two of the placement heads of two of our teachers' colleges that the conditions described as to teacher training and experience do obtain to a deplorable extent throughout the state.

In a city school employing some twenty on the vocational staff, only two or three have degrees. Several of the group are what are known as "practical men" who have not finished regular high school, but have supplemented their work with some correspondence and summer school work. Most of the others

are graduates of or holders of life certificates from state teacher's colleges. Only one member of this force is a graduate engineer who has taken the additional work to obtain a teacher's life certificate and a Smith-Hughes certificate. I want, in particular, to speak of two shop teachers who have obtained Smith-Hughes certificates without having teacher's life certificates. Both of these men are very competent mechanics, but they are deficient in general and in technical education. It is my opinion that the Smith-Hughes certificate should be given only to graduate engineers who have had the required experience and work in teaching method in addition thereto. Conversation with them immediately raises the suspicion in the mind of an engineer that they are lacking in background, as our academic friends would say. Pursuant of this idea, I journeyed to one of the state teacher's colleges. I resolved that I would visit in order all of the shops and also the classes in any technical subject that would serve in any way as a source of engineering learning, contact, or from which could be derived any element of this desired background. I was to be on the lookout for anything in the way of student activity or classroom work that would serve to make the future teacher in any way engineering-minded.

These observations I make as a result. There are few engineers on the faculties of teacher college vocational training departments. There are few practical classes in machine shop, forge shop, pattern making, or foundry practice -- in the school I visited, none. Mechanical drawing is given very

little attention. A concrete example of a shop course offered more recently by a state teacher's college reads as follows:

"The General Shop. 4 term hours.

This is a class-room course covering the underlying principles, the development and the problems of the organization known as "general shop." It is a practical course for those desiring to teach or supervise general shop work."

I think the words "class-room", "practical", and "for those desiring to teach or supervise general shop work" are significant. But to continue: only one small room in the basement of the training school was given over to mechanical drawing. In this mechanical drawing room there was a total enrollment of four young men. The teacher was a graduate of the manual training course of the same college. He was not a mechanical draftsman, at least not in the commercial sense. The group interested me and I was able to get them all into conversation. We were unanimous in the statement that it was easier to "place" if one took the work in mechanical drawing. Last of all I visited a class in manual arts. It proved to be nothing in the world but another variation of the methods' class. Children were making wicker work and a mixed class of men and women were observing. This I was told they did two days out of the five and on the other three days they took up a rather detailed study of the child and the outcomes to be expected. They also studied keeping a class interested, costs of materials, basket weaving as

combined with wood work, raffia and reed. The class would also touch a little on the history of the manual training movement and take up the matter of the value of manual training work in the rooms for backward children.

I state it, as my opinion, that if the average graduate of this school were to attempt to hold a job in any one of the trades on the strength of what he learned here, the the foreman would be very busy all day finding jobs for him that he could do without help. The reason that one is unable to find signs of much engineering background among vocational teachers is simply that there is none, except in isolated cases.

Please do not think that I came away from my visit with scorn in my mind. Nothing could be farther from the truth. The work given there in the academic branches is of a very high order of excellence. In the different classes in psychology and in the methods' classes, in fact in all of the academic work it is beyond reproach and I believe that no teacher, no matter how well he or she may be endowed by nature for the profession, should be placed in charge of boys and girls or, for that matter, of college students without having first taken the required training in modern psychology and in teaching methods.

I visited the department of mechanism, drawing, and design of a college engineering department. I had a splendid visit with the different teachers and with the head of the department. As I went through the great number of splendidly equipped rooms and examined the wonderful course of study, I thought, -- "What

a contrast." But in the midst of all this there was a distinct jarring note. One of the teachers of drawing said to me, in substance, apropos of a little discussion of class management; "We use few of the education department's ideas about teaching in our work here; we feel that the men who come here are old enough to eat for themselves; we do not feel the need of any type of motivation or interest gaining work; we have made up a good course of study and if it does not suit them they will have to leave it. All of this work must be in on time and must be exactly like the course prescribes."

Here, in this man, I had found the other extreme. He had the attitude that is all too prevalent among engineering school graduates. They feel as a class distinctly resentful at being asked to take the additional work in education to comply with the law. They should be willing to do more than this, they should not let any chance go by to study and keep up with the latest things in educational method. This extreme attitude as typified in the college teacher has done much to bring the engineering school graduate, as a teacher, into disrepute among the superintendents of the state. At the teacher's college the idea had been that the prime need of a teacher was to know method. On the other hand, there is the engineering graduate with practical experience also to his credit who does not know and in fact, rather scorns the idea of learning teaching method and psychology.

The teacher's college might, of course, put in an

adequate department to train teachers in vocational work and engineering, but the fact I want to bring out most strongly now is that the present graduates know practically nothing about things that are common to engineers. Yet, it is from this class that by far the greater part of the state's teaching force for vocational work is being recruited at this time. The few engineers there are in the system seem to be lost like ink in a lake.

We must not forget in this discussion to notice that of the teacher group the superintendents are, together with the principals, the most potent in shaping the courses and in framing the methods, aims, and policies. And these individuals are, almost to a man, academically trained and minded. To make matters worse, there are the few so-called practical men whom we usually find in the school machine and forge shops. They have obtained their Smith-Hughes certificates on the strength of their meager education and their years of practical experience. I cannot emphasize too strongly my idea that these men should be compelled to take adequate technical training for a Smith-Hughes certificate.

My investigation shows that while the vocational work is almost entirely of an engineering nature both in the high schools and in the junior colleges, the teachers, principals, and superintendents are usually academic in training and are almost totally lacking in engineering background and preparation, and however fine they may be as educators in other de-

partments, they are unfitted, as a class, to serve either in the guidance, growth, or teaching work of such a department.

I have reported conversations and have recorded my own observations in considerable detail. I wish now to draw a picture of an academically trained teacher at work in his school room shop. This will enable you to see with my eyes and draw, as I hope, the same general conclusions that I have drawn. It will serve also as a further contrast with the work and opinions of the teacher I described at the engineering college. This teacher in a wood shop talked freely of his aims and work. The substance of his talk follows. "Many of the parents want, and, in fact, persistently tried, during my first years here, to get me to make this into a kind of trade school. Some of them wanted a sort of employment agency in connection with the school that would seek to place students in proper jobs. But, due to the fact that so many of my boys go away to school and that so few of them take up engineering work and because, of those that stay at home, only a very few take up any form of wood working, the placement idea has entirely failed and I do not even consider it any more. Then, too, I find that the groups seem to vary so from year to year that I cannot have any definite plan or program. You just have to keep the boys interested or they will drop the course and it is about the only way some of them can be kept in school. Now the last few years I have come to see the matter in this way. I can tell you plainly that the aim of this shop is general education. Mr. B , the principal, and Mr.

C , the supervisor, both agree with me. The main thing is interest and motivation. I do not attempt any set program. Just as soon as I can, I get them to work, and each boy does whatever interests him. It helps them to grow up. It provides contacts. It is of inestimable values." As I listened to the familiar words, I seemed to see the teacher's college campus again -- motivation, interest, contacts, growth, self-direction, self-activity.

As we talked, we sought refuge in the "tool" room. A nondescript collection of wreckage, a few screw drivers, none of which had a properly shaped edge and all of which looked more like dull cold chisels, one wood chisel used "to open things", and other small tools that were hopelessly "no good" were scattered around the bench and rack. What was left of a half dozen hand saws were here and there and none of them were in shape. On the battered walls were neatly stenciled patterns, each with a hook, showing where the tool keeper of old had been taught to keep the fine assortment of tools with which the good people of the city had started the venture.

In one corner of the tool room was an imposing looking filing cabinet or cupboard which was arranged to hold fifty drawers. Each drawer was neatly arranged to hold the various hand tools that each pupil was supposed to have assigned to him. I examined one of these drawers, at the time doing service as a support for a varnished pot. It had nicely arranged pockets for square, marking gauge, back saw, bevel, nail set, hammar,

and chisels. Now all the places for such things in the shop were empty; most of the tools were gone. The thought came to me that some day the curious taxpayers might want to know how the back saws were holding out.

The shop, however, was the teacher's pride. A belt sander some twelve feet in length, a large band saw, a smaller bench band saw, a dish sander relegated to a corner, a newer type in use, an automatic saw filer, several electric glue pots, a large assortment of paints, stains, and varnishes, a splendid circular saw with all attachments, a jointer which I can only describe as expensive looking, a mortise machine, a post drill, a boring machine, a double wheel chisel grinder, an extra large wood lathe, twelve smaller wood lathes made up the list of visible machines. Then, there were twenty-four cabinet maker's benches of the familiar student type.

As we talked, a bell rang and the class dropped whatever they were doing and clustered around the door. Another ring and away they went. The two who had been playing with the band-saw left it running, and also left the odds and ends of wood, which had served them with much "self-activity" and nearly, I surmise, provided for a genuine contact, lying with the saw dust on the table. All of the machines, by the way, were individual motor drive.

I felt that this man must at times suffer in his mechanic's soul at the sight of so much waste and ruin and inefficiency. How could even his practiced eye pick out from such

a discouraging student mass those of promise, much less find means to encourage them to continue their work in college? Surely for such an engineer his slide rule, his hand books, his drawing tools, and his engineering school memories must be of a seemingly distant past. How could he bear to see such futile childish effort and waste of time and material as he called to mind the days of his own apprenticeship and the splendid patterns and other pieces of work that he himself had made during his years of commercial shop training? So I made inquiry. From the same high school in which he was employed, he had graduated from the college preparatory course and having completed the required two years at a normal college he had returned to his native walks and had served as vocational instructor ever since.

Now, does it not seem reasonable that there is a middle ground between the above and the college professor who took the ground that he was a tradesman and a commercial draftsman in addition to his educational work in technology, that he stood ready to instruct those who asked for instruction, that he and his colleagues had made up a course which had met with the approval of the head of his department, that this prescribed course of study and drawings, which were to be made in a certain prescribed manner, even to the exact size of the title, in the study room and in a certain prescribed time, must be completed before the aspirant could receive his degree, and that ideas of the student as to how and when he would like to draw would not be tolerated? Surely, between these extremes, there is a

qualification for teachers, a course of study, a common aim for vocational work, and a common standard of accomplishment.

Of course, what I have said so far is subject to just criticism. Those who find themselves in the line of my fire will be able to point out many discrepancies, and above all, they will say that my cases are not of necessity general, that many teachers are not of the category I have described. In reply, I submit it as my opinion based on quite a few years in school work in different parts of the state and based, also, on considerable investigation in preparation for this discussion, that the conditions are very bad and that the taxpayers are becoming seriously aroused.

The graduates of engineering schools such as Michigan State College or the University of Michigan could, if they would, enter the vocational teaching work of our high schools, bring about a wonderful reform. In the first place, as I have shown through this paper, they would serve to make the students and faculty engineering-minded. They would of necessity displace a part of the present faculty members who represent a type of training that may have been of value in the past social and industrial order that is now of little or no use in training for citizenship.

At a meeting of the high school principals held at Lansing, Michigan, Dec. 1-2, 1932, the discussions and papers were very interesting. I am inserting here a portion of the summary of the discussions approximately as it was reported by

a school journal. They feel, "that there should be at least one agency in every child's life to guarantee that he shall become a good citizen, -- not achieved by the school as now organized." Also a need was mentioned for "a form of curriculum focused more definitely upon present school problems." These changes in curriculum and in general aims will come very quickly after about one half of the members of the present faculty have been replaced by the engineers with experience and a strong natural leaning toward the practical things of social life, of economic life and of preparation therefor.

The schools need very much at this time, not an influx of Philistines, of uneducated mechanics, of expugilists, of communists, of socialists or other radical reformers as teachers, but instead they need an influx of level-headed practical Americans, men trained in the best that our engineering colleges can give, thus guaranteeing the highest type of mental capacity and integrity, men trained, also, in the latest types of teaching method and psychological knowledge and with this training an experience of several years in some field of engineering. Many of the above type of teachers will have to supplant those who believe that the source of the springs of economic welfare, good citizenship, and good family life lies in a study of classical languages, pure mathematics, and ancient history. With such new teachers in charge there will be less of repolishing the dead bones of men and ideas and more of study and practice in being a good self-supporting citizen of Michigan.

Reform in a school system is a matter of growth, not a process of tearing down and making over. The engineers with whom I advocate our teaching force should be rejuvenated should not and would not act as "reformers". These men would simply carry on and strive at all times for the things which their training and background would naturally lead them to strive. The needs of young people in the way of industrial training, both as a vocation and as work preparatory to college, would naturally be more intimately watched over by teachers more competent to judge, guide, and help; while on the other hand, the opportunities for contacts, finding information and experiences, occupational knowledge would be greatly increased in number and variety. Reform in the school aims, method, and course content would be slow but it would be sure, once the engineer trained and minded teachers were put in charge of the classes which seem to be quite naturally theirs: namely, physics, athletics, and shop.

The attitudes and aims of such a school would surely take on in time less of a leaning towards the worries and happenings of the world extending from Cleopatra and Caesar through the Renaissance and more closely approach the problems of the present work-a-day world. The schools would come in time to be interested in the things that concern our life and happiness as a nation, such as cars, pavements, city government, plumbing, heating, roofing material, and health. For the "finer" things

of life, they would study the fine art of being a self-supporting citizen of Michigan.

Bibliography

American Association of Engineers.

Edited by J. A. L. Waddell, Chairman,

Frank W. Skinner, Harold E. Wessman.

Vocational Guidance in Engineering Lines.

Easton, Pa., The Mack Printing Company. 1933.

Thomas, Frank W. Principles and Technique of Teaching.

New York, Houghton Mifflin Company. 1927.

Brewster, Edwin Tenney. Vocational Guidance for

the Professions. Chicago, Rand McNally & Company. 1917.

Newell, F. H. and Drayer, C. E., Editors.

Engineering as a Career. A series of papers

by eminent engineers. New York.

D. Van Nostrand Company. 1919.

Swain, George Fillmore. The Young Man and Civil

Engineering. New York. The MacMillan Company. 1924.

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