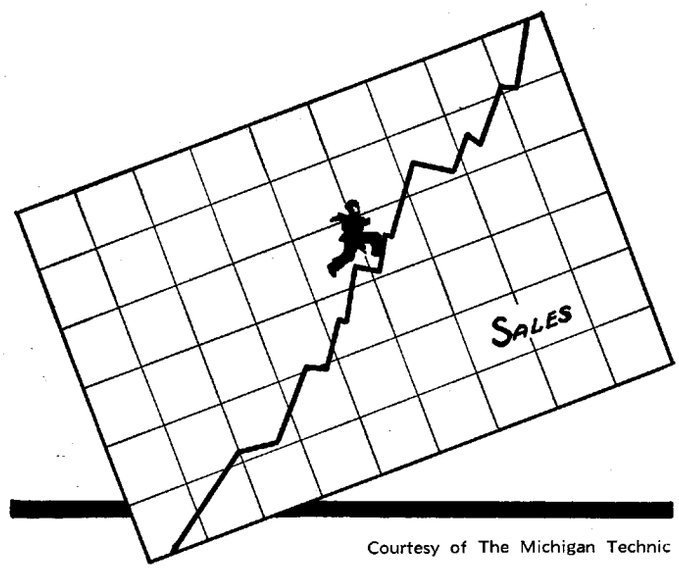
YOUR



Courtesy of The Michigan Technic

THE things that a person tries hardest to assure in his life are probably his own happiness and security. Most of us, whether we will admit it or not, think that money will be the basis of most of our happiness and security in later life and regardless of everything that we are told to the contrary, we shall endeavor to accumulate as much money as possible. Almost every student in engineering, when asked why he intends to pursue that particular profession, will say that he is studying engineering because he thinks that he will like that type of work. Perhaps that is true, but it is also undoubtedly true that the amount of income he will get for his work will determine to a great extent how well he likes it.

With the possible exception of a few survey courses the student has no chance to get a broad view of the engineering profession as a whole and then only the type of work to be expected is explained in these courses while authentic facts about the incomes and security of engineering college graduates are little discussed. As a result the student can only go through his college course hoping for the best and depending on hearsay in learning what his particular type of engineering has to offer to him as far as security of employment and income are concerned.

In 1935, at the request of the American Engineering Council, the Federal Bureau of Labor Statistics made a survey of the engineering profession, receiving data from 52,589 engineers who replied to their questionnaire. This is, no doubt, the most extensive survey of the engineering profession in recent years and the conclusions drawn from it would undoubtedly give a college student a general idea of what he can expect after graduation.

On looking at the statistics compiled in this survey one of the first things that one would ask himself is whether it really pays to graduate from college. Many of the present engineers had only secondary school educations, or took a non-collegiate technical course and seem to be as successful in their work as college graduates. Also many men who took non-engineering courses in colleges have followed the engineering profession very successfully. The following table gives the relative incomes of engineers with different types of educations.

Type of Education	*Year after Graduation*		
	2	10	30
	Median annual earnings, '34		
Secondary school education	$1,550	$2,025	$3,200
Non-collegiate technical crse.	1,475	2,010	3,150
College course incomplete	1,350	2,220	3,490
Non-engineering graduate	1,275	2,600	4,250
First degree engineering graduates			
Chemical and Ceramic	1,250	2,750	5,050
Mining and Metallurgy	1,200	2,550	3,980
Mechanical and Industrial	1,180	2,490	3,780
Electrical	1,080	2,500	4,250
Post graduates	940	2,610	4,175
Civil and Architecture	1,325	2,350	3,330

It is obvious from the table that the college graduate in engineering has no advantage over engineers with other types of education as far as starting salary is concerned, nor is there an appreciable difference after ten years in the profession. After thirty years the engineering graduate holds a distinct advantage over the others in some fields but in other departments there is no great spread in salaries even after this many years in the profession.

Neither did the engineering graduate hold any advantage over the others with respect to employment during the worst years of the depression. 37.8% of the graduates reported a period of unemployment during the years 1930-34 while 35.7% of those with college course incomplete and 35.6% of those with a non-collegiate technical course reported periods of unemployment.

It is obvious that until recent years the engineer with a college degree in engineering had no particular advantage over other engineers but, nevertheless, at the present time it is highly advisable to graduate from college if one expects to be an engineer at all. A few years ago, when competition was not so keen, it was much easier to get an engineering job than it is now. For all the years up to 1927, 27.6% of all engineers were not graduates. However, only 1.57% of the engineers who started practice between 1930 and 1934 were not college graduates. So, even though the men without college educations who broke into the engineering profession a few years ago have been as successful as college graduates, at present the odds are better than 98 to 1 that you cannot become an engineer without a college diploma.

Warranted that it is necessary to graduate from col-

FUTURE IN ENGINEERING

By Joseph Fenwick and Elgar Brown

lege to become an engineer one might wonder whether the engineering profession pays one well enough to go to the bother of attending an engineering college for four years or whether some other college course might offer more opportunities. Although it is difficult to say what kind of training is most advantageous, it can be pointed out that in 1929 only about 6% of the incomes in the United States averaged more than the income of the average engineer with ten years experience. Furthermore, engineering is a profession in which earning capacity advances and is substantiated until late in life.

But if in these respects the profession appears attractive on the average, its rewards are not particularly attractive to the poorer and less fortunate engineers. Even in 1929 the lowest paid 10% of the engineers could hope for no more than $2,500 to $3,000, though they might stay in the profession for 40 years. Judged from the basis of money income there can be no question but that the best group of skilled wage earners are in a better economic position than these who struggle to maintain a position on the fringes of the engineering profession.

Since the economic status of some engineers is not too favorable, one wonders if it might be some weakness in college training that might be the cause. Many engineers recommend greater stress on Economics and English in college but outside of that the classroom training itself seems to be sufficient. Participation in activities seems to have an effect on what the engineer is likely to learn, however. It seems quite probable that very often lack of success in the engineering profession may be blamed upon some weakness in classroom curriculum when in reality the cause lies within the engineer himself for not getting as much out of college as he might. After graduation the engineer finds that he not only has to make use of his technical knowledge, if any, but must also be successful in his relations with a large variety of individuals. To do this he should cultivate those qualities which may best be described by such terms as:

Personality	Promptness
Loyalty	Accuracy
Patience	Judgment
Humility	Aptitude
Breadth of interest	Proper estimate of
Business ability	own value
Leadership	Executive ability

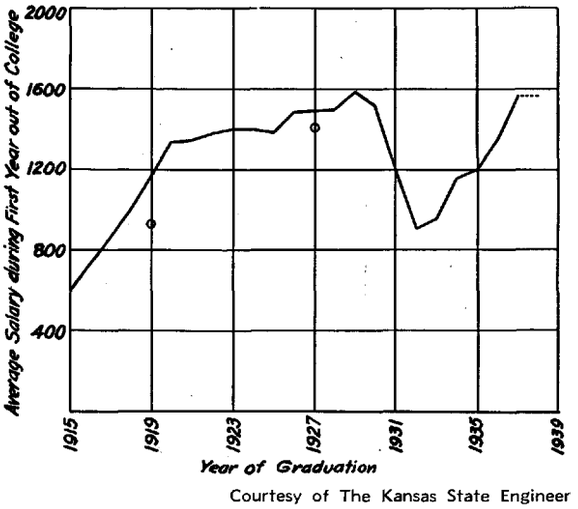
It is quite evident that as school is now conducted many of the above traits are not born in the classroom, but rather are the responsibility of the student himself, insofar as their development is concerned.

Although the aforementioned qualities are largely a result of many years of training in the home, in industry, and in our public schools, the best means for their development in college seems to be through extra-curricular activities. In activities a student may meet fellow students, professors, and business men upon an equal basis and express himself in a way that is utterly impossible in the classroom. The training in ability to deal with people successfully is probably responsible more than any other one thing for the fact that salaries seem to vary almost proportionally with the number of activities that one participates in while a student. The following table shows a comparison of income vs. grades and incomes vs. activities. An index number of 100 is used.

Grades	*Income*	*Activities*	*Income*
T B H	101	Many	108
Over 3.5	105	Intermediate	102
3.0-3.5	98	Few	101
2.5-3.0	101	Worked	97
2.0-2.5	95	None	95

To the mind of the student who is considering engineering as a profession comes the question, "Just what do engineers do and what are their earnings in general?" Also blanketing the scene is the ever present cloud of possible unemployment.

Engineering employment may very well be divided into three classes; those employed in private industry, those employed regularly by different government agencies, and those unemployed or engaged in governmental work relief. During the depression a very decided shift has been and is now taking place from employment by private industry to government work. The shift of engineering employment during the depression can be analyzed by a table.



Courtesy of The Kansas State Engineer

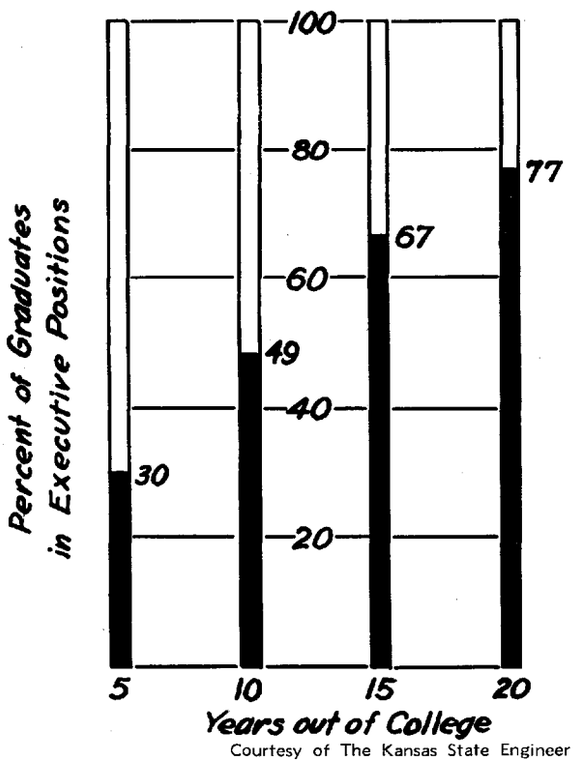
Employment in Engineering Profession
1929-34

Employment Status	Percent 1929	1934
Engineering Employment	93.0	77.4
Private	71.9	52.7
Public	21.1	24.7
Non-Engineering Employment	6.4	14.1
Unemployed (Including relief work)	0.7	8.5

From the above table it might be indicated that in the depression years from 1930 to 1935 there was considerable total unemployment in the engineering profession. However, never at any one time were more than 3% of the engineers totally unemployed, although almost 40% of the members of the profession reported a period of unemployment during the five year period. From this we may conclude that although temporary unemployment was rather common, unemployment of the more serious nature was relatively rare.

Nothing seems to indicate that such a low percentage of unemployment will continue, however, because the number of men graduating is far in excess of the number of men being accepted into industry at present. In fact there were 141% more men graduating in the period 1930-34 than in the period 1925-29 while there were only 34% more young men accepted in private industry in the 1930-34 period than in the 1925-29 period.

Since we have conclusive proof that up until the present only a small percentage of the engineers are without jobs one might wonder how much those who are employed are making.



Courtesy of The Kansas State Engineer

By tabulating the available statistics on the matter we can get a general idea of what a person contemplating a life work of engineering can expect to make both during prosperity and depression.

Median Annual Earnings with Respect to Years After Graduation for all Engineers

	1929	1934
At graduation	$1,313	$ 598
After 5 years	3,145	1,858
After 10 years	3,674	2,569
After 20 years	4,588	3,211
After 40 years	4,968	3,497

With a general idea of what income to expect in the engineering profession the next question one might ask is what type of engineering work brings the largest income. Types of work with respect to income can be rated in the following way:

1. Sales
2. Technical
3. Non-technical
4. Education

It is obvious that, as far as salaries are concerned, teaching offers the least opportunity. This phase of work may, however, offer inducements that can hardly be measured in terms of a slight difference in earnings.

Knowing now that sales engineering looks like the most promising type of engineering work we wonder what department of engineering in which it is most advisable to matriculate. There are several angles at which this question may be viewed. The wages of various types of engineers may be compared at any particular time. The change in wages due to the depression might be noted. The increase in graduates with respect to the increase in jobs is also an important aspect. Data has been accumulated which can give the inquisitive college student a view from all of these different angles. For instance the relative incomes of various branches of engineering and the change of incomes due to the depression are as follows:

Median of annual earnings in each professional class including both graduates and non-graduates

Department	1929	1934	% decrease 1929-'34
Mining and Metallurgy	$4010	$2628	34.5%
Chemical and Ceramic	3803	2047	46.5%
Mechanical and Industrial	3699	2324	37.2%
Civil and Architecture	3291	2297	30.2%
Electrical	3277	2218	32.2%

This table shows what kind of engineers make the most money and also the department affected the most by the depression. Then if one is anxious to know what branches of engineering are overcrowding the fastest, and all of them are overcrowding, he may refer to the following table.

Percentages of increase in each professional class 1929-'34

Professional Class	*% Increase in Graduates*	*% Increase in Total Employment*	*Private*	*Public*
Chemical and Ceramic	62.5%	35.1%	34.8%	38.8%
Electrical	32.8%	3.1%	−1.9%	78.0%
Mechanical and Industrial	25.5%	5.5%	1.9%	59.1%
Civil and Architectural	18.7%	1.1%	−30.6%	44.1%
Mining and Metallurgy	17.6%	2.5%	−1.0%	33.6%
Total U. S.	25.3%	4.4%	−8.2%	46.8%

Stability of employment in the various fields may interest the engineering student and data on this aspect can be tabulated as follows:

Percentage reporting a period of unemployment and average period of unemployment with respect to departments from 1930-34.

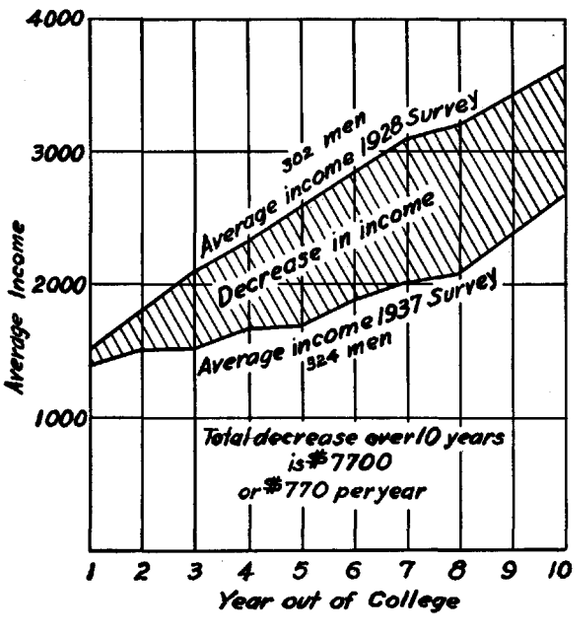
Department Graduated from	*Percentage Reporting a Period of Unemployment*	*Average Length of Period*
Civil and Architectural	41.8%	11.8 mos.
Electrical	36.9%	11.5 "
Mechanical and Industrial	35.0%	11.1 "
Mining and Metallurgy	33.9%	12.3 "
Chemical and Ceramic	33.5%	9.4 "

The tables above give about the best picture available of the respective merits of different types of engineering. Wishing to show no partiality and realizing that the reader's conclusions are just as good as the writers' we will let the reader reach his own conclusions with regard to what type of engineering is most promising.

It may be that some students in engineering hope to find better wages in other types of work. Some comparison may be made between the wages of engineering graduates who are following the profession for which they have been trained and those who have accepted work in other fields.

The age of maximum earning power for engineers arrives more quickly for non-engineering than for engineering work. In 1929 the average annual income of engineers engaged in non-engineering was slightly higher than the income of those following their profession. However, not more than 7% of the total of any engineering classification found work outside of their field. Nearly all of this 7% came from the men who had formerly been in the upper income brackets in following the engineering profession. Those men of the lower income brackets in engineering seemed to fail to get attractive openings in non-engineering work.

By 1934 many men of the lower income brackets



Courtesy of The Kansas State Engineer

were forced to accept non-engineering work in preference to unemployment or work relief. As a result, the average income of engineers following non-engineering work was considerably reduced.

Comparison of Annual Earning for Non-Engineering and Engineering Work in 1934

Years After Graduation	*Non-Engineering Work By All Engineers*	*Engineering Work By All Engineers*	*Engineering Work By All Graduates*
Starting salary	$ 744	$ 642	$ 617
5	1296	1929	1946
10	1992	2676	2801
20	2892	3319	3540
40	2200	3793	4280

So far in this article it has been shown that at present, although it has not been the case until the last few years, the college graduate has a distinct advantage over the man without a college education. There has been definite proof that participation in extra-curricular activities will have more effect on the engineer's income than grades. It is also likely that the graduate choosing to take up sales engineering will probably make more money than the graduate who goes into teaching. Much data has been given on the respective merits of different departments of training and differences of income has been noted. It has been shown that the graduate in engineering will probably make more money if he sticks to the work for which he was trained. But the most significant differences in income revealed by the survey are not the differences in average income received by individuals who have received a college degree or those who have not. Nor are they the differences as between individuals who have entered one professional class rather than another. These differences on the whole are moderate though they are large enough to prove the

desirability of choosing well both the field of endeavor and the type of training best adapted to advancement in that field. The most striking differences are those which exist within each profession and within each group classified on the basis of its educational background. One out of every ten of the engineers in each such group secures an income several times as great as the average for the group as a whole. At least one out of every ten at the bottom of each group whether a college graduate or not, whether a chemical engineer or a civil engineer, whether a man of many years of service or freshly out of college, is hardly to be distinguished as regards income from a skilled wage earner. For instance in 1939 in mining and metallurgical engineering the average income of the upper 10% of the profession was $7,530, while the average income of the lower 10% of the profession was only $1,308. No man can expect his choice of type of engineering education to make that much difference in his income. The biggest difference in income will be due to the man himself.

Undoubtedly college courses are becoming increasingly difficult in order to weed out those undesirable to the profession. Now as never before employers are differentiating between college graduates and non-graduates. However, even yet many individuals of limited capacities secure college degrees. As a result employers must develop more selective processes in employing men. Now simply graduating from an engineering school does not guarantee a satisfactory income, but the man who graduates with indications of outstanding capacity will undoubtedly earn several times as much as the man who merely slips through, regardless of the department under which either has been instructed. So even if one is a junior or senior in engineering and for some reason or other feels that another type of engineering is more promising, he should remember that the best men in every type of engineering earn much more than the average men of the type of engineering in which salaries are highest. So one's success will not be due to what kind of engineering he has learned but to what he is able to do with this knowledge after he gets it.

It is a matter of common belief that college training has economic value for the prospective engineer. What there is about the college training that helps most is hard to tell.

Even after 30 years in the profession the spread between the salaries of college trained men and non-college trained men is increasing. It can hardly be argued that the scholastic background of engineers who entered the profession in 1900 is a controlling factor with reference to their earnings in 1929 and 1934. Certainly, the value of their services is no longer primarily dependent upon the odds and ends of information which they acquired in college, although it is possible that habits of thinking and study which the engineer received in his college days constitute a permanent legacy. By and large the factors controlling the value of a man's engineering services after 30 years or more of experience must be primarily his native capacity and the training which he has received on the various jobs that he has performed.

As regards native capacity, there is reason to believe that, on the average, better material will be found among college graduates than among those who failed to complete a college course. There are, of course, many individuals who are unable to complete an engineering course for financial reasons. There are also many individuals of limited capacity who receive degrees. But there is also a wholesale process of weeding out that goes on in the engineering schools. Thus even the differences in income shown in the earliest years of experience may reflect differences in capacity rather than differences arising from the value of formal training.

It is a matter of common knowledge that for a number of years a college education has been thought of as a normal prerequisite to engineering work. Many employers of engineers deliberately differentiate between the college graduates and the non-graduates. In this sense status is gained by graduation, to some extent no longer with regard to the value of a formal education as such. In other words the employer may hire the young graduate engineer not because he has possession of the formal knowledge given in a formal engineering course, but because he promises capacity for work since he was able to graduate.

It was stated, however, that many individuals of limited capacity secure engineering degrees. As a result many employers have already developed a highly selective process of employment in interviewing candidates from engineering colleges. They may assume that college graduates are more promising material than non-graduates, but no longer do they recognize the mere fact of graduation as evidence of employability and give special status only to those who graduate with a standing substantially better than the average of the class. Thus the advantage of status which may have occurred a number of years ago through the fact of college graduation alone now accrues in equal measure only to graduation with exceptional standing. So, graduation from an engineering school is no guaranty of a satisfactory income, while there is still apparently an opportunity for a man of outstanding capacity to secure far better than an average engineering income even though he has not attended college.

It is hard to advise a boy just out of high school or a freshman or sophomore in college just what the future holds in store for him and what type of training will be most advantageous. It can be pointed out, however, that in 1929 the average income of graduate engineers with 10 years experience ranged from $3600 to $4600 in the various professional classes. In 1929

only 6.4% of the incomes in the U. S. exceeded $4000. Furthermore, engineering is a profession in which earning capacity advances and is sustained until late in life. But if in these respects the profession appears attractive to the average, its rewards are not particularly attractive to the poorer or less fortunate engineers. Even in 1929 the lowest paid 10% of the engineers could hope for no more than $2500 to $3000 though they might stay in the profession for 40 years. In 1934, exposed as the profession was to the risks of unemployment, the lowest paid 10% of the engineers with less than 5 years experience after graduation earned less than $1000. Even with 10 to 30 years experience they earned no more than $1000 to $1500. Judged from the basis of money income, there can be no question but that the best of a group of skilled wage earners are in better economic position than those who struggle to maintain a position on the fringes of the engineering profession.

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