And there are other qualities that make for leadership: tact—the combination of good judgment with good taste in dealing with others; self-confidence without self-conceit; a personality that attracts men, wins their confidence, holds their loyalty. It is qualities such as these that make the leader of men. It is such choice qualities as these that the atmosphere of our universities ought to develop in their students. Was it not with such high ends in view that our universities were founded?

Your splendid new building has higher purposes than a mere mill. You will not rate its success in dollars and cents of annual profit. And I want to protest against the too common standard by which we rate the success of men. You tell me that this graduate holds a $25,000 position, that another owns a rich copper mine and a third is president of a colossal trust. Have they achieved success? Very likely; but why not apply to them the same standard that we apply to your university?

The true measure of success, alike for the university and for its graduates, is the test of public service.

I know an engineer who has through long years guided the destinies of a great city, saved to its taxpayers untold millions of dollars, fostered its development in a way that will benefit generations yet unborn.

I know an engineer who dared to risk his professional reputation and his life to uncover fraud upon the commonwealth and to punish the guilty.

I know an engineer who has turned a barren desert into fruitful farms, has made possible prosperity and happiness to thousands and tens of thousands.

It is true that the public seldom appreciates the value of such services as these, and those who render such service often receive only meager reward; and yet I tell you that it is achievements like these that best deserve the name of success.

Shall we not then dedicate your new building to the culture of such high ideals? Within its walls may all noble traditions, all honorable standards, be fostered and upheld. May those who go forth from its influences carry with them a rich spirit of loyalty—loyalty to the public welfare, loyalty to their city, their commonwealth, their country. So will they justify those who to-day dedicate this building to public service.

CHARLES WHITING BAKER

THE NEW COLLEGE OF ENGINEERING, AN OPPORTUNITY[1]

A GREAT opportunity is before us. Through the generosity of Mrs. G. F. Swift and Mr. Edward F. Swift an excellent building for the new College of Engineering has been erected and its maintenance provided for. The board of trustees has determined to furnish the necessary funds to develop the new college. It will start with all the advantages, and they are many and not easily measured, of being a new department of an old and prosperous university, rather than a new, separate organization. Those persons at Northwestern who have fostered for years the idea that engineering should be taught at this university have had high ideals for the new college which have already helped it. The position of the new College of Engineering, within easy reach of one of the greatest centers of commerce and industry in the world, will furnish its students and professors unusual opportunities to keep in touch with the practising engineer. The new College of Engineering is being started at a time when the methods of engineering education are rapidly changing and developing. This is, therefore, an opportune time for it, if properly guided, to take and

[1] Address delivered at the dedication of the new College of Engineering of Northwestern University by the director-elect.

to hold one of the leading positions in the progress of engineering education. It is much easier for a new organization to develop along new lines than for an old organization to learn new ways.

In order to utilize well this great opportunity it is important that we should have a reasonably well-defined ideal toward which to strive. The ideal should be one from which effective working plans may be developed. To work without an ideal is to invite disaster from the changing currents of general tendencies and of personal opinions, and the strong deep currents of prejudice, or to invite disaster upon the shallows of undirected effort. To choose too high an ideal, one toward which we can not make considerable progress in our approach, is to provide for the formation of working plans which will be ineffective, discouraging to the workers, wasteful of effort and resources.

We might take it as our task to convert the high-school graduates who come to us as freshmen into men who will leave these grounds five or six years later as engineers fully trained and completely equipped mentally for their life work. This ideal can not be even approximately attained. To adopt it would lead to misdirected effort and to wasted opportunities.

Instead, our ideal should be so to train these young men in college that they will be capable of becoming engineers, and will have a tendency to become great engineers. We may hope to make a reasonably close approach to this ideal. We may hope to lay such a foundation of motives, of methods of thought, of principles which have been mastered, and of acquired information, that our graduates may, with accumulated experience and strength acquired by effort, become good engineers ten years after commencement, and in the unusual cases become great engineers within twenty of service.

Having this as our ideal, some of the general features of our working plans will follow naturally.

As it is not our purpose to attempt to graduate fully equipped engineers, we need not attempt to give each student special training in the particular narrow branch of engineering which he expects to follow. We need not attempt to teach the future railway engineer all the minutiæ of that occupation. We need not try to give to the future sanitary engineer all the specific information needed in his chosen line. As our purpose is to equip the graduate for unlimited growth as an engineer, rather than for the greatest immediate usefulness, it is obvious that we should put the emphasis in our teaching strongly upon the fundamentals which are the basis of the specialization in engineering, upon mathematics, chemistry, physics and mechanics.

So, too, in selecting the purely engineering courses which are to be given, each should be examined to ascertain the extent to which it is fundamental, the extent to which it deals with principles of broad application, rather than with principles applicable in a narrow field only, or with mere engineering information. A selection among engineering courses must be made, for it would probably require at least eight years in college for any one student to take all of the different courses now offered to undergraduates in colleges of engineering.

In teaching the broad principles which underlie engineering, in passing to the student that well-organized knowledge contained in the text-books and treatises on engineering which has aptly been called concentrated experience, the college has great advantages over the school of experience. On the other hand, skill, special knowledge and that familiarity with details which is a part, but not all, of experience, may clearly be best obtained outside the college, in the practise of engineering.

These considerations indicate approximately how to make the difficult decisions as to the amount of shop work, laboratory work and drafting which should be put into our curriculum. These courses serve in part one purpose, to illustrate principles, to make them concrete and thereby both to strengthen the grasp of the student upon the principles and to increase his interest in them. These courses, especially if made extensive, also serve another purpose, namely, to develop some skill and judgment in the manipulation of instruments, tools and apparatus. In accordance with our ideal, we should endeavor to stop when the first purpose has been accomplished. To endeavor to accomplish the second purpose also by more shop work, laboratory work and drafting during the college years will necessarily crowd out other courses in lines in which teaching may be done much more effectively in college than out of it.

The student should, however, be encouraged to engage in practical work connected with engineering, during his summer vacations. He may gain from this, in somewhat the same manner as from his first experiences after graduation.

In the statement of our ideal we have acknowledged that the embryo engineer has much to learn after he leaves college and before he becomes a full-fledged engineer. It follows, therefore, that it will be a mistake to keep him too long in college, just as truly as it will be a mistake to turn him out too soon, with too little training. With each year added to his life, the man tends to become less quick to learn new ways, less keen to profit by new experiences. We should not delay unnecessarily the date on which our graduate begins his work in the world. While he is in college he is surrounded by men who are endeavoring to teach him. He has put before him organized knowledge, carefully arranged and carefully presented. As soon as he steps out of college, or at least as soon as he rises above the lowest rank in his profession, the knowledge which it is most important for him to acquire is that which lies outside the field of well-organized knowledge. It comes to him in chaotic fashion. His fellow workers and his official superiors have but little interest in helping him to learn, and have still less activity in that line. With each additional year the young man stays in college, it becomes more difficult for him to adjust himself to this radical change in conditions when he goes out.

For the present, we have adopted a five-year course for engineers. Past experience in colleges of engineering shows that a four years' course is too short. The considerations just touched upon should lead us to examine with care any other considerations which seem to indicate that the course should be extended to six years.

The adopted five-year course for engineers is so arranged and provides for such liberal training that at the end of the first four years the successful student will have fulfilled all the requirements for, and will receive, the degree of bachelor of science from the College of Liberal Arts. An engineering degree will be granted at the end of the fifth year.

We have adopted as our ideal the proposition that we are to train engineers for the greatest average effectiveness in the first year after graduation. We should, therefore, avoid sending out our graduates handicapped by ignorance of men. The young engineer, or the old unsuccessful engineer, so long as he remains in such a minor position that he has no official subordinates and never needs to take the initiative, is but little handicapped by ignorance of men. But as soon as he begins to rise, and in proportion to the extent to which he must necessarily depend on those below him for details and for loyalty, on those around him for cooperation, and must be trusted by those above, his progress is dependent upon knowledge of men. Cases are not infrequent in the engineering world in which the upward progress of an engineer is absolutely stopped by his clumsiness in dealing with men, even though he has great skill in dealing with materials and forces. It is our duty to teach our future engineers not only about forces and materials, but also about man and his ways, to bring it before them with emphasis that their future success in utilizing their engineering knowledge and skill depends upon their ability to work with men, among men and through men.

In the College of Engineering we may expect certain difficult problems to be ever present, intertwined with a multitude of other problems. The success of the college depends largely upon our success in solving these problems which are easily overlooked and neglected because of their familiarity. I intend to suggest but three examples.

Language is one of the important tools of an engineer. He must ordinarily do his work through others. He must have the power to convince. He must have the ability to use English accurately and effectively or be handicapped even in his strictly engineering work. One who acquires the ability to speak and write accurately and well, usually secures with it the power to think accurately. How can we best help the student in his college days to acquire the ability to speak and write well? This is a problem common to all colleges and to all universities. To one who deals much with recent graduates, it is discouragingly evident that but mediocre success has been attained in universities in solving this difficult problem.

It is a comparatively easy matter to lead a student along a given line of thought, but how can the student be trained to think for himself? That is one of the exceedingly difficult problems which confront us in the College of Engineering in common with all parts of the university.

We should aim, in the College of Engineering, to give our students a broad training, yet we desire to give them thorough training along certain lines. How is the broadening to be secured? Is it to be gained from certain courses intended for that especial purpose, or is it to be secured by the manner of teaching each course, even technical courses? This, again, is a problem common to nearly all, if not all, parts of the university.

The real success of the College of Engineering is dependent upon the solution of ever-present problems of which these are but examples. Because of the existence of numerous problems of this character which are common to the whole university, the College of Engineering gains strength from being a part of Northwestern University, rather than a separate institution. Because the engineer has a peculiar point of view, and the courses in engineering have some special advantages in connection with certain of these universal problems, the College of Engineering may hope in time to contribute a share toward the solution of these problems in this university.

Let us adopt as the motto of the College of Engineering the words, "Culture for usefulness." Let us put the emphasis strongly on the last two words. The first word alone may lead one astray, but the three together are a sure guide. The attempt to gain culture for the purpose of increasing one's usefulness in the world is essentially unselfish. In setting this motto before our students and in thus suggesting that they are to seek culture, not primarily for themselves, but in order to increase their usefulness in the world, usefulness of the broadest kind in the great united struggle of man for progress, we shall be setting before them an ideal which includes all others, an ideal which urges one to the broadest attainable culture, in college and afterwards, an ideal which is inspiring and invigorating to any one who realizes its meaning.

We are here to-day to dedicate a building to engineering education. In a deeper and better sense, we are here to dedicate ourselves to the highest and best use of the great opportunity which the building represents, an opportunity to give an uplift to the ideals and to increase the usefulness of thousands of young men who are to enter their life work through that building, an opportunity to help in raising the standard of engineering education, an opportunity to help in making American universities of greatest real service to American people.

JOHN F. HAYFORD
NORTHWESTERN UNIVERSITY

COMPARATIVE ENROLMENT OF STUDENTS OF ENGINEERING

IT is generally supposed that the attendance on the engineering schools of our country continues to show the rapid gains that have marked their development during the past ten or fifteen years, and while at the majority of the institutions the enrolment of to-day compared with that of say five years ago would exhibit a healthy increase, an analysis of the accompanying table proves that a reaction is apparently beginning to set in, at least at a number of the institutions. It will be seen from the table that the present total attendance of engineering students at twenty-four representative institutions shows an increase over last year of only one hundred and ninety-one students, or one of 1.15 per cent. The figures given include students of engineering, mining and metallurgy, and chemistry, but are exclusive of students of architecture (with one or two exceptions), agriculture, forestry, biology, etc. It should be noted that a number of institutions (for example, the Massachusetts Institute of Technology) have one or more of these last mentioned courses, and that the figures in the table do not, therefore, represent in every case the *total* registration of the school. In some instances (for example, Michigan) graduate students are included, in others (for example, Columbia) they are not; most of the institutions submitted the spring registration, but in a few cases the fall figures are given, and there may be several other minor differences, yet in spite of these discrepancies, the table as given will convey a sufficiently accurate idea of the most recent changes in engineering attendance. Owing to the regulation requiring a baccalaureate degree for admission to the school of applied science, which has recently become operative at Harvard, the figures of this institution have been omitted, since a comparison would be somewhat misleading. Thirteen of the institutions exhibit a gain in attendance over last year, while eleven show a loss. It is interesting to note that of the independent schools six show losses in attendance as compared with last year, whereas only five of the schools connected with universities have experienced a decrease in enrolment since 1907–8, while eight schools connected with universities and five independent schools show gains.

Institution	Registration		Increase or Decrease	
	1907–08	1908–09	No. of Students	Percentage
Cornell University	1,638	1,727	89	5.4
Purdue University	1,398	1,364	—34	— 2.4
University of Michigan	1,325	1,335	10	0.7
Massachusetts Institute of Technology	1,259	1.297	38	3.0
University of Illinois	1,059	1,081	22	2.1
University of Wisconsin	940	906	—34	— 3.6
Ohio State University	839	888	49	5.8
University of California	794	818	24	3.0
Yale University (Sheffield Scientific School)	788	793	5	0.6
Columbia University	618	717	99	16.0
University of Minnesota	647	677	30	4.6
Rensselaer Polytechnic Institute	609	660	51	8.4
Lehigh University	662	646	—16	— 2.4
Armour Institute	521	518	— 3	— 0.6
Worcester Polytechnic Institute	462	487	25	5.4
University of Missouri	466	444	—22	— 4.7
Case School of Applied Science	479	431	—48	—10.0
University of Nebraska	439	396	—43	— 9.8
Stevens Institute of Technology	435	390	—45	—10.3
Colorado School of Mines	349	380	31	8.9
Michigan College of Mines	266	277	11	4.1
University of Iowa	239	218	—21	— 8.8
Rose Polytechnic Institute	223	206	—17	— 7.6
Tulane University	145	135	—10	— 6.9
Total	16,600	16,791	191	1.15

RUDOLF TOMBO, JR.