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SEEKING TOMORROW'S ENGINEERS

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SEEKING TOMORROW'S ENGINEERS

by Donald G. Dickason

At a time when the country has seen some of the greatest engineering feats in its history, engineering schools find themselves recruiting vigorously in a vain attempt to meet the requirements for graduates. Despite current dislocations of engineers in some industries and in some regions of the country, the fact remains that there is a continuing demand for 25 percent to 50 percent more new engineering graduates each year than are being produced.

In the middle ground between demand and supply stands the engineering college admissions officer, in a position to view the long and complex process that culminates in new engineering graduates. Where do engineers come from, how are they to be found, what are they like, where are they going? What are the problems in the recruitment of engineers, and how can these be met? Answers to these questions involve not only admissions strategies and programs, but also changes in engineering curricula and in the profession itself, and changes in the culture of young people in a changing society.

ENGINEERING IN THE CONTEMPORARY WORLD

A student considering engineering today faces new demands, not in terms of personal qualifications, but in terms of the world around him. The student finds the same requirements now that he always has for the ability to analyze, to apply science, mathematics, and logic rigorously to specific technical problems, and to generalize knowledge in order to encompass new problems. The changes have been in his surroundings. Not only has there been an "explosion" of knowledge that he is expected to master, but there are new demands, both physical and social, of the environment in which he must apply this knowledge. Implementation of the concept of engineering as technology applied for the benefit of mankind has never been more seriously thought about and sought. Students today, as never before, are caught up in the triangular relationship of science, technology, and society.

Has engineering lived up to its social responsibilities, or has it been more

concerned with its technological means than with its social ends? Have engineers been involved in the major decisions affecting society, or have they left these responsibilities to their nontechnical friends? If engineering as a profession has been too far removed from social concerns, what are the reasons? These are the questions today's prospective engineering students are asking—more often, more articulately, and far more seriously than ever before.

CURRENT STUDENT PERCEPTIONS AND ATTITUDES

There is a second, more subtle, more complex, and less understood difference in youth today. Students, as a sociological group, have formulated values that are dramatically different from those of their predecessors. The whole culture has moved from the so-called Protestant ethic, with its well-defined vocational motivations, toward a peer-oriented and guided set of values. The rigor and goal-oriented nature of engineering was ideally suited to the student bred in the psychology of the Protestant ethic, which had as dominant characteristics the desire for avoidance of failure, the expectation of success, and the willingness to take risks, put forth effort, and persist in an activity. The sociopsychological disposition of youth today has shifted dramatically from these earlier characteristics. Many experts feel that the dominant mode now is that of being "peer oriented" or "other directed," an attitude almost antithetical to the Protestant ethic. Many young people perceive that engineering is inconsistent with their basic sociopsychological disposition, and even though this disposition is relatively independent of any value judgment *per se,* about engineering, the net result can have—has had—an effect on the generation of student interest in engineering.

CHANGES IN PROSPECTIVE ENGINEERING APPLICANTS

In addition to these differences in today's students, are there other changes evident to the admissions officer? Nationally, engineering still attracts very able students. Among the semifinalists in the 1969 National Merit Qualifying Test, 19 percent of the men—the largest single group—indicated engineering as their first educational choice. Another indication of excellence is the fact that applicants now, as compared to ten years ago, show equal or higher ratings in the various measurements of academic capability. (However, the myth that applicants of earlier generations "couldn't get in today" should be laid to rest. The superior qualifications of secondary school students today are a result of superior preparation, not necessarily of greater ability; today's students have had high school calculus, PSSC physics, honors this, and enriched that.)

Also undergoing change is the social and economic makeup of the applicant group. Engineering students have long been thought of as coming from lower income groups. This is still somewhat true, but at Cornell this factor has largely disappeared as a way of differentiating between engineering and liberal arts applicants (see Table 1). A slight increase from 1969 to 1970 in the percentage of engineering students

Table 1. Educational Backgrounds of Parents of Cornell University Students

The figures apply to parents of students who were freshmen in 1970 in the College of Engineering and in the College of Arts and Sciences.

	Fathers		Mothers	
	Engineering	Arts and Sciences	Engineering	Arts and Sciences
Advanced degree	22%	31%	39%	33%
Bachelor's degree only	31%	28%	6%	11%
College (no degree)	13%	10%	10%	10%
No college	34%	31%	44%	46%

whose fathers did not attend college can be attributed to Cornell's increased efforts to recruit applicants from minority groups. The number of such applicants, notably blacks, is rising. The number of women applying for admission to engineering schools is also increasing, although not yet dramatically: an indication is that only 0.5 percent of the women National Merit semifinalists indicated engineering as their first choice of profession. These developments are discussed in more detail below.

CURRICULAR SHIFTS IN CORNELL'S ENGINEERING DEGREE PROGRAMS

The increasing concern with the social implications of technology, and the changes in the students now being educated in engineering schools, are being accompanied by changes in the educational process itself. Traditional distinctions among fields of engineering have been blurred by interdisciplinary relationships in virtually every area. This interdisciplinary tendency, together with the steadily increasing amount of knowledge to be mastered, has brought about two seemingly paradoxical changes in undergraduate engineering curricula. The first is the increased depth and breadth in basic mathematics, science, and engineering science to which students are exposed. The other development, at least at Cornell, is the sharper focus upon a specialty during the upperclass years, a change made possible by giving the students more opportunity to select courses.

One result of these shifts in curriculum has been an increase in the proportion of humanities and social sciences studied, and changes in the nature of these courses. Even though Cornell's baccalaureate degree program in engineering has been reduced from a five-year to a four-year sequence, the student now takes about the same number of courses in the liberal studies area as he did ten years ago. He now has greater freedom of choice, however: in 1960, almost two-thirds of the liberal studies courses were specified, but in 1970 all but two are elective, and these two are limited only to the "natural or relevant social sciences."

The proportion of physical science

"The many interfaces of biological science and engineering are . . . likely to be one of the largest growth areas."

Table 2. **CORNELL ENGINEERING CURRICULUM**

Liberal Studies Content

	1960-61 (five year curriculum)	1970-71 (four year curriculum)
Number of courses	11	8-12*
Number specified	7	0

* There are two free electives in the upperclass years which may be taken in liberal studies or any other discipline. In the freshman year, there are two "natural or relevant social science" electives.

and engineering courses that are specified has shifted significantly, too. In 1960, virtually all the student's physics, mathematics, and engineering courses were predetermined; in 1970, about two-thirds are elective or are specified only after the student has chosen an upperclass field of specialty. This change is a result of the way the curriculum has been restructured. Now the student is enrolled during his underclass years in a Basic Studies Program which specifies ten out of a total of fourteen to sixteen quantitative courses. As a junior he enters one of eight fields of engineering or he chooses Cornell's unique College Program, which permits an almost unlimited number of interdisciplinary options.

It is obvious that our modern curricula include more basic science, and this has caused some criticism that engineering education is "too theoretical" or "not practical enough." This is not a new problem. A Cornell Engineering Journal of 1917 lamented, "It is impossible to give the student very much practical work." A response to this sentiment has been manifest in the development of programs for technological education at various levels: two-year community and junior college associate degree programs (both "terminal" and transfer "science" types); four-year courses leading to bachelor of engineering *technology* degrees; and one-year graduate programs leading to *professional* degrees (for example, Cornell's Master of Engineering degree), in which an increasing number of graduate engineers enroll. These are all programs oriented to the practice of technology.

CURRENT TRENDS IN CAREER DIRECTIONS

Though most engineering schools do not require choice of "major" in the freshman year, there are changing patterns of tentative interest worth noting. Chemical engineering remains stable, primarily because of its visibility to high school students having success and interest in chemistry. Aerospace engineering has passed its previous peak, perhaps because some of the "romance" of the unknown has vanished, or because of recent publicity about employment dislocations in that industry. Electrical and electronics engineering shows some signs of a slip from its position as the major engineering field. The computer sciences and associated areas are stimulating more and more interest, especially when combined with electrical engineering, industrial engineering, or operations research. The many interfaces of biological science and engineering are now being pursued by students; this is likely to be one of the largest growth areas throughout this decade. There is a similar developing interest, though perhaps less noticeable now, in the interfaces between the oceanographic sciences and engineering. And finally, the environmental engineering areas are stirring significantly increased student interest.

Choice of a career is of course greatly influenced by employment patterns, and these have in general become more varied in recent years. In the past, the greatest portion of graduates proceeded directly to industrial employment or to engineering service in governmental or public agencies. In the pattern of recent years, only ten to fifteen percent of Cornell's baccalaureate graduates choose to seek imme-

Cornell freshmen move in—a job for fathers and mothers, too.

diate employment. Fifty-five percent wish to continue their education in the professional master's degree program, and most of these students seek employment at the end of that fifth year. Another fifteen to twenty percent wish to undertake graduate work through Master of Science or Doctor of Philosophy programs in engineering or applied sciences. Fifteen to twenty percent decide to pursue graduate degrees in business, law, medicine, or other professions. There is increasing recognition that engineering education is relevant to further study in many other areas. For instance, a significant number of graduate business schools are actively seeking engineering undergraduates as applicants, and they report that employers often prefer business school graduates with undergraduate technical educational backgrounds.

It is appropriate to note that even last year, when there was a marked decline in employment recruitment of scientifically trained graduates in general, engineering graduates continued to have ample opportunities. Though the number of job offers per man decreased (a graduate may have been able to choose from only three job offers instead of seven or eight), the average starting salary increased more than five percent. And as indicated earlier, though there has been some dislocation among employed engineers, there is still a large overall unmet demand.

ADMISSIONS PRACTICES

The objective of finding the best possible group of students for a freshman engineering class is partly a matter of recruitment, and partly one of selection. In the admissions decision process at Cornell, three general attributes of applicants are considered. First is the academic record, which embraces all evidence concerning the student's ability to carry out the required work. This evidence includes high school grades, class rank, academic evaluation by the high school counselor, College Entrance Examination Board scores, American College Testing scores, and other nationally-normalized data. If the candidate is judged to have satisfactory academic qualifications, the selection committee then assesses personal characteristics and attitudes. Does the candidate have potential for gaining much from an engineering education? Can he be expected to contribute something of value to the profession? Some might call this "motivation." We have referred to it as awareness of and commitment to engineering. "Awareness" implies an understanding of the profession in both its educational and professional aspects, and a perception of the educational differences between engineering and non-engineering baccalaureate programs. "Commitment" to us means the degree to which a candidate projects a strong desire to take advantage of what an engineering education has to offer.

At Cornell we have been trying to improve the effectiveness of our selection process, for although our record of retention of students is well above average among university-based engineering schools, there are still far too many engineering students who leave the field. (Although the *academic failure rate* of Cornell engineering undergraduates is comparable to that of students in our College of Arts and Sciences, the *retention rate* is considerably lower. It may be noted, however, that the percentage of Arts and Sciences students who switch from science to nonscience majors is slightly higher than the percentage of students who leave engineering.) Those who transfer from engineering have almost the same median academic qualifications as those who remain, so analysis of academic factors has provided us little help in finding solutions to the problem of attrition. A longitudinal study of the freshman class which entered engineering at Cornell in the fall of 1967 is now under way and is beginning to provide some hypotheses of interest. Two of the thirty variables included in this study are (1) the assessment of "awareness" and "commitment," and (2) a personal characteristics rating. Although results are too preliminary to permit firm conclusions, there is some evidence that these two ratings do have significant relationships to retention and are highly independent of traditional academic predictors. This is an example of the type of research and inquiry which must be pursued if there is to be an improvement in the efficiency of the educational output of engineering colleges.

A corollary result of the analysis of awareness and commitment ratings is the evidence that a sizable portion of students *who matriculate* have minimal knowledge of the educational process of the profession they have chosen, or of the nature, potential, and scope of the engineering profession itself. Engineering colleges must recognize this ignorance and take steps to correct it during the student's first year. The

"Two major pools of untapped talent seem to have escaped effective attention: these are minority group students and women."

prospective engineer must have a basic knowledge of science and mathematics, but he must also have a much improved understanding of how this knowledge is put to work in engineering and in society.

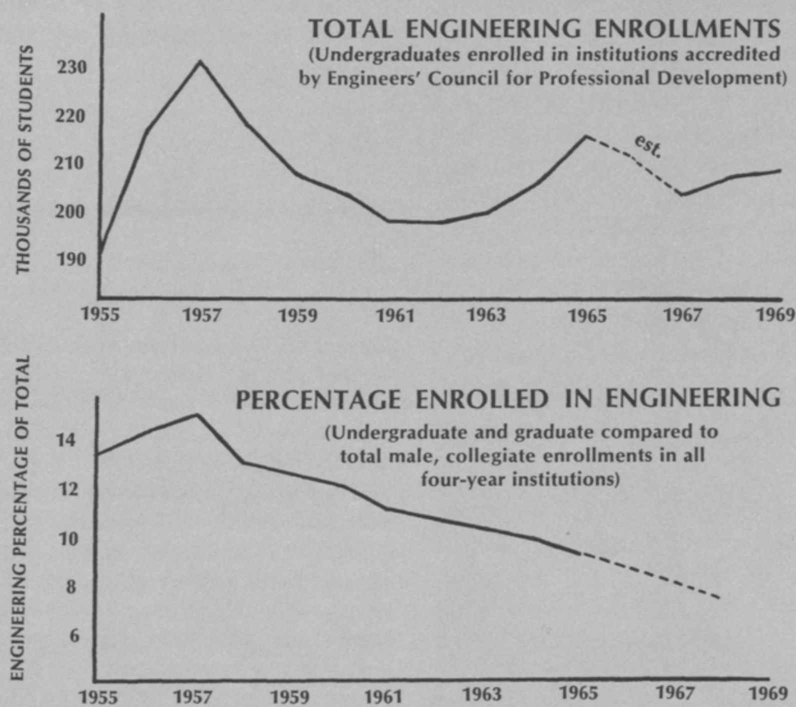
NEEDED: NEW, UNIFIED, SYSTEMATIC APPROACHES FOR STUDENT RECRUITMENT

Efforts on the part of engineering colleges to "recruit" students during their senior year of high school result primarily in competition among the various engineering colleges for the best available talent from a relatively inelastic supply of interested students. If any long-range increase in the pool of talent is to occur, efforts at recruitment must be made at a much earlier point in the students' lives. Research on vocational decision making indicates that many pupils form lasting career preferences by the time they are in the ninth grade.

Greater effectiveness in recruiting engineers would also result from a greater unification of efforts of the many technical and professional societies which over the years have carried on recruiting and information programs of one sort or another. Until recently, these efforts have been almost totally directed toward individual disciplines; that is, mechanical engineering has "advertised" mechanical engineering, electrical engineering has promoted its field, and so forth. More recently, the Engineers' Council for Professional Development (ECPD) and its director for guidance have begun to emerge as the coordinating mechanism for a united effort to promote engineering more effectively. This approach is overdue and highly necessary because of the diversity and extent of counseling secondary school guidance must encompass. It is difficult enough for counselors to cope with engineering as one profession, let alone as a whole spectrum of disciplines. What is needed is a unified, systematic approach drawing on the resources of each of the technical societies, the National Society of Professional Engineers, the ECPD guidance staff, industry and other employment sources of engineers, and the engineering educators of this country.

Another factor in recruiting engineers is the increasing cost of education. College costs have outstripped the capabilities not only of many students, but of the financial aid resources of the colleges, especially private colleges, that seek to assist them. Total costs at most schools are now so large that few if any students can finance all their expenses by working. The average amount of loans assumed by students has grown greatly in the past few years, and it is not now unusual for a young graduate to begin his first job with a debt in excess of $4,000. These financial aid problems are intensified as more and more minority group students enter colleges and universities. A very practical solution here is for the users of the product—the employers—to plow back a portion of their revenue to the producers of the graduates, just as they now reinvest funds in their own research and development programs. If each employer of an engineer would contribute a percentage of that engineer's productivity to help educate another one, the financial problems of engineering education would be largely solved.

Figure 1



NEW GROUPS WORTHY OF ATTENTION

While total engineering enrollment at the undergraduate level has been creeping upward, the proportionate share of students in engineering—even considering males alone—has markedly declined (see Figure 1). Two major pools of untapped talent seem to have escaped effective attention: these are minority group students and women.

The latter group is more easily reached, but so far women have not appeared in significant numbers in any engineering school in the country. There are straws in the wind which suggest the means for change, however. Women are finding a more ready welcome from many of the traditional fields, and this word is gradually spreading. Also, some of the newer disciplines such as computer technologies, environmental technologies, and operations research, which do not have traditional "male images," are exciting the imaginations of many talented young women. Compensation for graduate women engineers is almost at parity with that of men. For example, in 1970 the average salary offered to new women graduates with the baccalaureate degree was $10,300, as compared to the corresponding figure for men of $10,400. However, the profession has a long way to go in appealing to women, and engineering will correctly be accused of being shortsighted if it does not move aggressively to attract this talent. This, incidentally, should not be regarded as just a reaction to the Women's Liberation Movement but more correctly as a means of attracting the personnel which the profession and the country need.

The attraction and enrollment of minority group students—predominantly, but by no means entirely blacks—presents a more complicated challenge. This could, however, be one of those rare situations in which the end result is good for every participant. The black engineering graduate would have a professional education. The black community could benefit from the presence of technically trained people who would have a particular and firsthand knowledge of the social problems, many with major technical components, that need solution. The engineering profession would be bolstered by the additional imput of highly motivated and energetic young people. And the engineering colleges would benefit by the infusion of new ideas and viewpoints that are currently missing for many students from majority groups.

To date, however, few engineering schools in the United States have succeeded in enrolling even 5 percent of their entering classes from minority groups. Why? One reason is the deficiency many of these students have in prerequisite work in high school mathematics and science. The relatively structured curriculum (as compared to liberal arts programs) which the engineering student must pursue after matriculation contributes to the problem of entrance qualifications. There are solutions to these problems, however. More and more minority group students are now attaining secondary school educations that include the necessary prerequisite work. In addition, transitional programs are being developed, and "stretch" programs are being offered so that the motivated student with insufficient preparation can take additional work to bring him to the necessary level of competence. For instance, Cornell now provides prefreshman summer courses in physics, chemistry, and mathematics. And this fall, as many as one-fourth of our entering minority students may well *elect* an extra year in order to provide the basis for satisfactory progress through the regular curriculum. If the engineering profession is serious about promoting the benefits which can accrue to all parties in this particular situation, it needs to exert great effort toward implementing a variety of ingenious methods to accomplish those ends.

SUMMARY

It should be quite clear that in the 1970s the admission of students is but one small part of the whole process of producing engineers, and but one part of what now appears to be a whole set of related problems. Much can be done, if it will be done. Recruiting needs to be refocused and unified in its efforts to reach a broader cross section of secondary school students. Increased efforts must be made to identify those who are most likely to take advantage of engineering education and to contribute to the needs of the country through professional activity. The working engineer needs to be more actively involved in the decision-making, value-judgment councils of the nation, and to continue his search for a better understanding of the social implications of his actions. And the engineering admissions officer must function not merely as a "gatekeeper" but must serve as an intermediary between the secondary schools and the college, as an interpreter of the students to the faculty, and as an educational "R and D man" to help improve the complex operations involved in strengthening our national engineering force.

Donald G. Dickason has been director of engineering admissions and student personnel at Cornell since 1966, and before that he served as director of admissions relations for the University.

A native of Wooster, Ohio, Dickason was graduated from Cornell in 1953 with a bachelor of arts degree in economics. He later returned to Cornell to earn a master of education degree in guidance and personnel administration. While an undergraduate, he was elected to Phi Beta Kappa, and in 1953 he was the National Collegiate Athletic Association and the Eastern Intercollegiate Wrestling Association champion in his weight class.

He served in the U.S. Navy Supply Corps from 1953 to 1956 and was discharged with the rank of lieutenant, junior grade. He was employed by the Central Soya Company of Fort Wayne, Indiana, and Marietta, Ohio, from 1957 to 1963.

Mr. Dickason is a member of the Association of College Admission Counselors, and is currently serving as vice president of the national organization. He was president of the New York State section in 1968. He is also a member of the American Society for Engineering Education, and is serving as guidance coordinator for the New York and New Jersey region for the Engineers' Council for Professional Development.

THE NEW BREED

Conversations with Cornell Students

The next generation of leaders in American engineering will come from the ranks of students now enrolled in the nation's colleges. How they feel about their future, and the futures of the profession and of the nation, is bound to have an impact on the directions in which engineering will move. A group of Cornell engineers, ranging from freshmen to graduate professional degree students, all scholastically successful and enthusiastic about their educational and career plans, were interviewed in the spring of 1970 by Quarterly *editors Donald F. Berth and Vicki Groninger. These interviews formed the basis of a series of essays which appeared in the College's new* Engineering at Cornell, *a publication prepared for secondary school students interested in engineering. We felt that excerpts from these conversations would be of interest to readers of the* Quarterly.

Interest in engineering started early for **Spencer Carter,** a Cornell freshman. "From a young age I was fascinated by crystal radios," he says. "I had my own rocketry lab at home, too. I experimented on different sources for combustion, trying to determine which would burn most efficiently and leave the least amount of residue." Spencer has already made up his mind about what he wants to do as a career: he hopes to become a designer of systems for improved space communications.

The entrance into an engineering specialty is not made until the junior year at Cornell, however, and so Spencer is now enrolled in a Basic Studies program which covers the first two years in the College. The program includes courses in the fundamentals of math and science as well as an introduction to the various fields of engineering, and a number of electives. "I discovered that engineering is not just lab work," Spencer says. "You need to know a lot of math and physics. Luckily, I dig those subjects and both departments are excellent at Cornell."

A John McMullen Scholarship made it financially possible for Spencer to come to Cornell. Each year one hundred freshmen are awarded these

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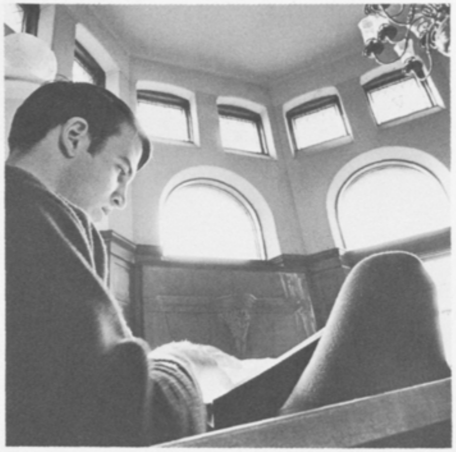


1.

1. Spencer Carter, a freshman from Harrisburg, Pennsylvania, has a part-time job in the engineering admissions office. Here he confers with director Donald G. Dickason.
2. Bruce Doak waxes his skiis in preparation for a day on the slopes near Ithaca.
3. Freshman physics lab period finds Chuck working on an experiment in angular momentum.
4. Bruce and Chuck find fossil hunting in the Ithaca gorges a substitute for mountain climbing in their native Colorado.
5. A favorite place of study for Chuck Doak is the Uris undergraduate library.

4.

2.

3.

scholarships, which may cover as much as the entire four-year tuition cost.

One of the things Spencer likes most about Cornell is the challenge of being with people "who are on an intellectual par with you or above. You can actually feel the quality of the education."

Freshmen **Bruce** and **Chuck Doak,** twins from Denver, decided to study at an eastern college in order to get to know another part of the country, and they chose to study engineering on the basis of talks with several college representatives who visited their high school and with some professional engineers.

Bruce and Chuck say they realized from the start that interest must be high to achieve success in engineering studies, and that organization of time is essential. "You have plenty of time for outside interests if you organize," Bruce says. He studies an average of thirty-six hours a week, from 8 P.M. to midnight most evenings and during free hours in the day, and reserves several hours every day for fencing. Chuck notes that concentration is also essential. "Last semester I had some trouble working efficiently. I was trying to study in the dorms. Now that I work in the library, things are much better."

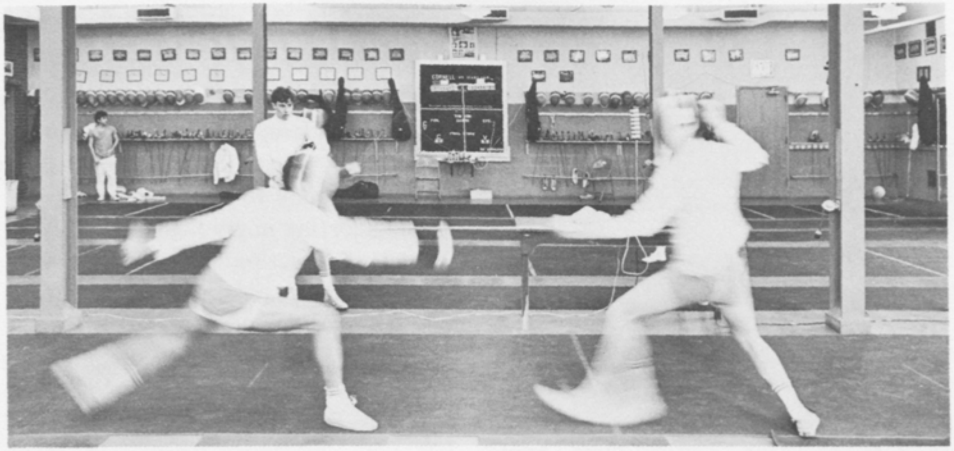
The boys are already making tentative plans for their areas of specialization. They feel that the Cornell freshman program called "Meet the Professors" has given them a good opportunity to explore various engineering fields by talking with faculty members who are working in those fields. Bruce is thinking of majoring in engineering physics, with the ultimate goal of a career in aerospace engineering. Chuck has decided he is "really interested in the notion of discovery" and is planning a career in research.

Engineering physics is the major being considered by **Paul Wozney,** a sophomore from Schenectady, New York. Planning to specialize in electrical engineering in graduate school, Paul thinks engineering physics will give him excellent preparation in fundamental mathematics and physics. He feels that his interest in engineering physics was triggered by a course in quantum mechanics. "The professor left you wondering after each class, what's the electron going to do tomorrow?" he explains.

He got his first inkling of what college life and engineering education might be like from a Future Scientists of America program he participated in at a midwestern university. At Cornell Paul received advanced standing in math and physics, so he had free time to take more than the usual number of courses outside the engineering curriculum. He has studied psychology, economics, and sociology, and is looking forward to following up his interest in Russian history as soon as his schedule allows. Paul says he detests the "plug and grind" type of course, and likes the flexibility which the new engineering curriculum gives.

Paul says he is interested in the "why and how" of electronic phenomena, yet also likes to work with things and see the results of his work. This is one of the reasons he chose to study engineering rather than a science. "The engineer, contrary to what some people think, is essentially creative, applying theory to reality," he says. "There is beauty in a perfectly functioning device."

Physics is the first order of business for Paul Wozney, who plans to major in engineering physics, but he takes time out from studies for an occasional game of broomstick polo.



"I wondered if I could do it," says sophomore **George Gull,** reminiscing about his decision to come to Cornell. There are more students enrolled in the College of Engineering than there are citizens in his hometown of Edgemont, South Dakota. However, George has not only made the dean's list but has found time for part-time work under the University's work-study plan. "You soon learn how to manage your time when you have a part-time job," he says. He helps Professor James Houck of the Department of Astronomy in analyzing data from observations of the Orion nebula made at the Kitt Peak National Observatory in Arizona. In addition to working at his job and participating in a number of extracurricular activities, George served as a student representative on the College's Policy Committee, which was responsible for recommending that the faculty adopt the changes now incorporated into the College's core curriculum.

George says he was attracted to the engineering profession by his desire to build and create. He has done some work in leathercraft and spent a summer working for a small wood products company near his parents' home. An example of his interest in building things is sometimes visible on the Cornell campus, where George pedals the unicycle he built while in high school.

Research in biomaterials is the career choice of **Dennis P. Carroll,** a junior from Grantville, Pennsylvania, and so he chose to enter the newly instituted College Program instead of one of the upperclass Field Programs. The College Program is designed to give engineering students an opportunity to develop an individual course of study which is often interdisciplinary and therefore not fulfilled by one of the Field Programs. Dennis is concentrating on courses in materials science and chemistry in preparation for research in such an area as the creation of artificial organs or the effects of radiation and isotopes on organisms.

Dennis is pleased that Cornell is situated in a small community away from the bustle of the cities and yet offers a wide variety of diversions such

Opposite: Sophomore George Gull, who is thinking of majoring in engineering physics or electrical engineering, enjoys his physics lab work. His day may also include lunch at the Martha Van Rensselaer cafeteria, and fencing practice.
Right: Dennis Carroll, an outdoor enthusiast, admires the Fall Creek falls just below the Cornell campus. Breaks between classes may find him at the Temple of Zeus coffeehouse on the Arts Quad. Dennis feels that a valuable aspect of a Cornell engineering education is the opportunity for engineering students to take courses in many other divisions of the University.

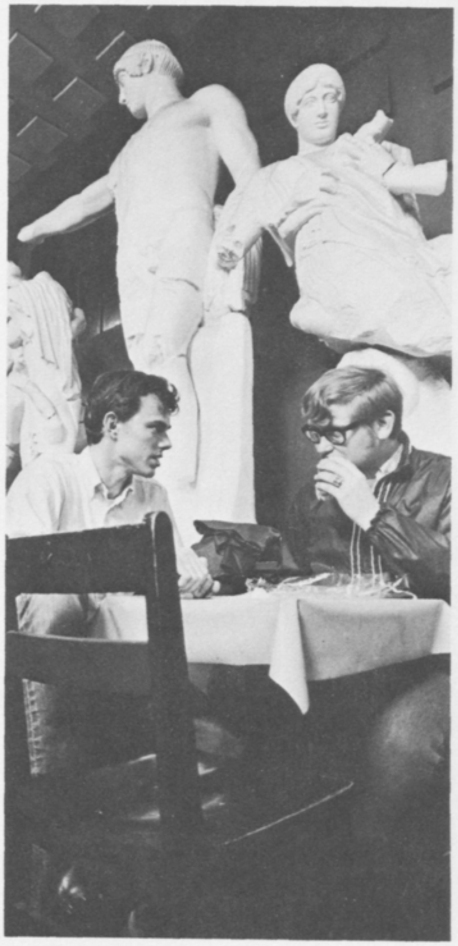
as lectures, concerts, and movies. He is also glad that he can pursue his many outdoor interests. His hobbies are horticulture and landscaping—for a summer job he worked at a nursery—and he likes horseback riding, canoeing, and travel.

Dennis enjoys taking courses in areas outside the engineering curriculum and mentions as especially interesting some classes in neurobiology and in attention and memory. In fact, his fascination with the learning experience has led him to consider teaching as part of his career. One reason he came to Cornell is the presence of the other colleges and the opportunities they provide for study in a variety of subjects. "I saw the statement old Ezra made, 'I would found an institution where any person can find instruction in any study.' Everything's here. If you have a spark flickering, you can pursue it."

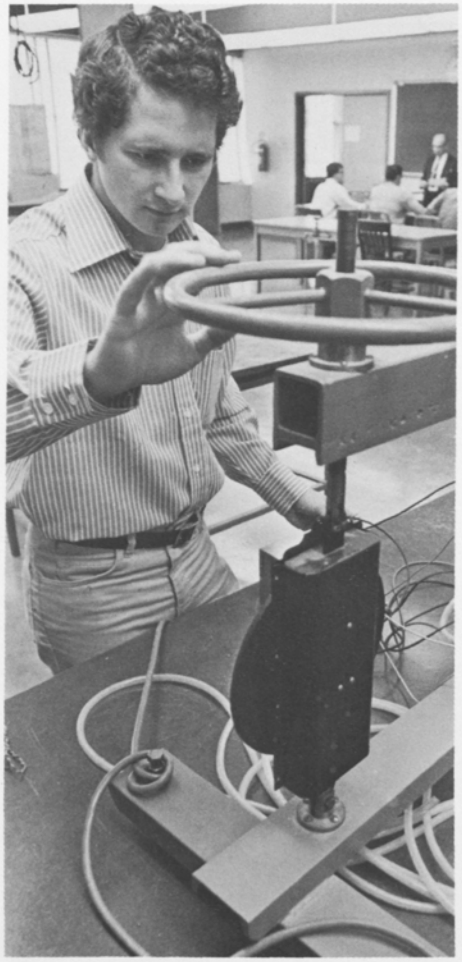
Terry Hartmann is another student with wide-ranging interests who has been able to meet his requirements through the College Program. He has a major in mechanical engineering and a minor in business. Terry, a senior, plans to do graduate work in the international aspects of business, with the idea of ultimately combining an engineering career with international management activities.

The most exciting aspect of Terry's undergraduate education was his participation, during his junior year, in the College's exchange program with the University of Poitiers in France. "I wasn't sure that I could cope with engineering instruction in French," he says, "and I wondered whether there would be serious discrepancies in course work between the two schools, but I saw doors being opened to all sorts of new opportunities—meeting people, studying engineering in France, and skiing on the Olympic slopes of Grenoble!" Comparing the two schools, Terry says, "The French lecturers seemed somewhat more theoretical and there was less after-class discussion there."

Terry explains his attraction to engineering and his interest in international activities simply. "Engineering seemed to provide a background that



Terry Hartmann, a senior from Richmond, Indiana, hopes to practice engineering management in an international context. Left: Terry performs an experiment in the thermal engineering laboratory. Right: Terry, whose minor field is business, attends a class taught by Professor Earl Brooks of the Graduate School of Business and Public Administration.



would offer a wide range of career possibilities. And then, I had a good French teacher in high school—perhaps that's one reason I was so open to the Poitiers experience and why it was so satisfying." He may also have been influenced by his brother, who majored in international public affairs as an undergraduate, and by his father, who is an engineer.

The Cooperative Program of the College of Engineering helped **Roger Berman,** a senior electrical engineering major, decide on his career plans. Until he began his Co-op training the summer after his sophomore year, Roger had been undecided about whether his interests were mainly in electrical engineering or in patent law.

Under the Cooperative Program, students take jobs with one company during three different periods of time after their sophomore year of study. The companies provide jobs that relate to the students' academic interests and educational backgrounds. Roger worked as a lab technician and then as an assistant design engineer for the Xerox Corporation in his hometown of Rochester, New York. He designed, built, and tested analog circuits, worked on the logic design for large-scale, integrated, sequential circuits, and did computer programming.

Roger remarks on the ease with which a broad engineering background can be adapted to specific problems. "Before I worked for Xerox I knew nothing about logic design. However, my education had taught me where to look and how to learn, and shortly I became more knowledgeable about it."

Roger first got interested in electrical engineering when he found that his intuition couldn't satisfy his curiosity. He says, "I wondered why an amplifier amplifies, for instance. I had no intuitive feeling about this." His need to work and to relate to people also led him into engineering. "In an engineering field, I could see how my solutions to a problem would affect people."

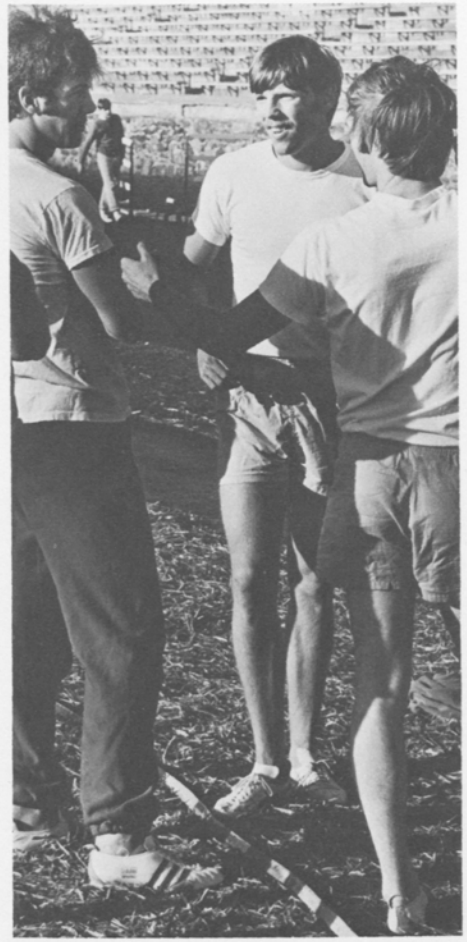
A member of a minority group in the College of Engineering is **Terry Leventhal,** a senior co-ed majoring in industrial engineering.

Terry says she was interested in computers and applied mathematics all through high school. She hesitated to apply to Cornell because, at the time, computer science could be studied only in the College of Engineering and she "didn't have the faintest idea what engineering was all about." She applied to other colleges as a potential math major, but then, after talking with an industrial engineer in Baltimore who described some of the interesting applications of computer science in the engineering field, she began to think, "What's wrong with being an engineer, anyway?" Later, after several dates with engineering students, she discovered that "they were in the same boat —they hadn't all built radios or rebuilt the family car!" Terry plans to complete a master's degree in operations research and then work for Bell Research Laboratories.

One of Terry's favorite courses in her major dealt with simulation. She worked on a term project that required the students to simulate a small luncheonette: they had to arrange the tables to make the best use of accommodations for the lunch rush hour. "Simulation is easy," she says. "It's the statistics that are hard."

Terry feels that changing attitudes in industry and in the colleges should help bring in more women. She points out that "there are many nonengineering applications of the hard sciences one studies in an engineering school, and companies are trying to become broader in their activities." She also feels that the growing concern among many students about the effects of technology on life and the environment should make an appeal to women who may not have a great interest in the "science of things."

Left, top to bottom: Terry Leventhal goes over a computer print-out with Professor William L. Maxwell. Roger Berman, who is managing editor of the The Cornell Engineer, *a student magazine, attends a staff meeting, and interviews Wally Rippel, who is working on a control system for a Master of Science degree in electrical engineering. Below: Only engineer on the Cornell Women's Lacrosse Team is Terry Leventhal, a senior from Baltimore, who is planning a career in computer sciences.*



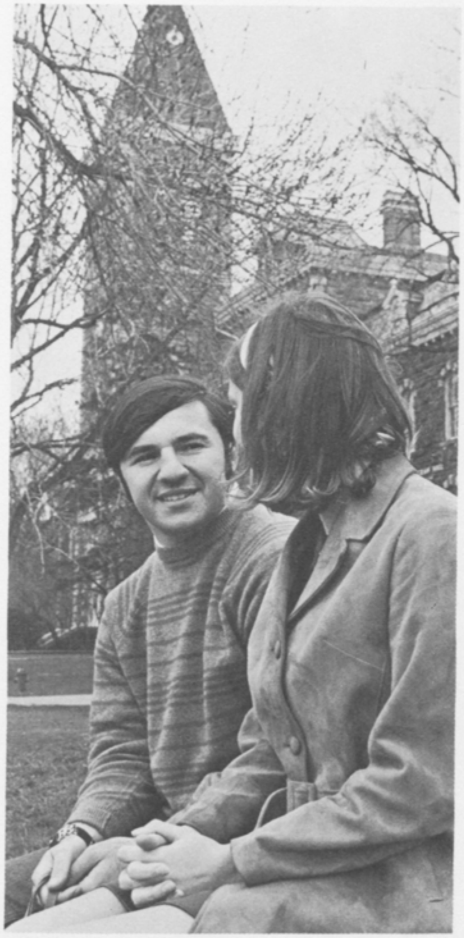
Interest in the "science of things" is still, of course, high among most prospective engineers. **Robert E. Kingan,** a graduate student in the Master of Engineering program, is one of these. "When I was a kid, I had a fascination with how things worked," Bob recalls. "I took motors and watches apart, and built things out of wood. And today I'm frustrated when I'm learning theory alone; I want to see where knowledge can be applied."

It is not surprising that Bob spends much of his time in Cornell's Electric Vehicle Laboratory, where he is working on the accelerator for an electric engine as his design project. This project is one of many being pursued by candidates for the Master of Engineering (M. Eng.) degree, which has no thesis requirement. Course work in this one-year graduate program is integrated with the upperclass curriculum.

Bob decided to continue his engineering education at the graduate level after working for a summer for a California aerospace company; this experience helped convince him that he needed at least another year of schooling. He has found that course work becomes more interesting each year, "perhaps because you close in on your real interests." He hopes to work in electronic equipment design.

Bob feels, though, that the coming emphasis in engineering will be on "saving this planet." "We're wrapped up in this ecology question now, and I think there will be growing humanistic interests in engineering," he says.

Environmental studies is a field of



Opposite: Graduate student Robert Kingan relaxes in his lakeside rented cottage after a day's activities that include work on his master's degree project in the Electric Vehicle Laboratory, and on the athletic field. Bob has a part-time job as assistant track coach, specializing in pole vault.

Above and right: Gary Cokins pauses on the campus between classes which include a popular undergraduate course in Bionics and Robots taught by Professor Henry D. Block of the Department of Theoretical and Applied Mechanics. Gary feels that diversity in activities and course work is important to a college education.

increasing interest to engineering students. **Gary Cokins,** a junior from Riverside, Illinois, is thinking of urban planning as a possible career. "First off, I like people-oriented activities," Gary explains, "and secondly, I realized that nearly all of us will be in trouble in a few more years unless something is done to solve the problems of the cities. This is one area where I can put my engineering know-how to work constructively." He has already spent a summer working with the Chicago Transit Authority's Department of Research and Development. One of the courses he has found especially valuable is the civil engineering offering, Highways and Airports—Planning and Design. Gary is now enrolled in the School of Industrial Engineering and Operations Research, and is considering studying for a master's degree in environmental systems engineering.

Gary also has an interest in probability and statistics which led him to develop, while still in high school, an analytical hobby he calls "dice baseball," a way of predicting the performance of individual batters in the major leagues. He is now taking a popular undergraduate course called Bionics and Robots, in which he is engaged in a project that will help him predict, on the basis of the batting averages of their individual players, how teams will finish the season.

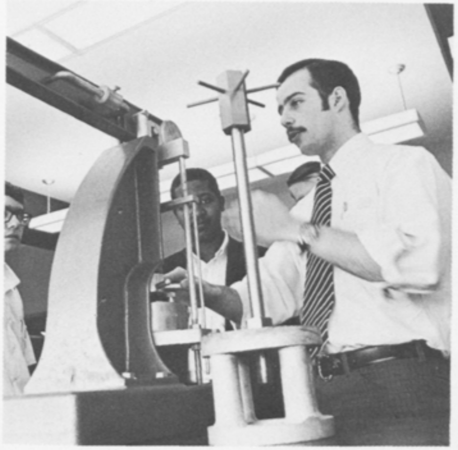
A good football player, Gary had the opportunity to go to several big schools. He chose Cornell because he was "itchy to move on to something new and different." "Everything you want is here," he says. "Cornell is just big enough to be able to offer all sorts of things."

Left: Otis Sprow takes part in an afternoon "bull session" at the Chi Psi fraternity house; attends a class in mechanical engineering, his major field; and confers with Professor Dennis G. Shepherd, director of the Sibley School of Mechanical Engineering.

Environmental and social problems are also of great interest to **Otis W. Sprow,** a senior in the School of Mechanical Engineering. He feels that air pollution, for example, is a matter of special concern to mechanical engineers, who are "the dirty people." His career goal is to design engines—turbo machinery and aerospace propulsion systems—and he plans to study for a Master of Engineering degree in mechanical engineering.

At Cornell, Ottie has been an active participant in campus life, playing on the football team and serving as president of a fraternity. "I haven't yet run into frustrations because of my color, and I believe part of this is due to my attitude," he says. "I don't go into situations with a clenched fist." Although he is not an activist in the Black Liberation Front, an organization of black students on campus, Ottie believes that the group serves a useful purpose. "It has given the black on campus a sense of identity."

Ottie feels that of all the problems facing America today the most urgent is that of the urban poor. During inter-



Left: William Bruno, a Master of Engineering degree candidate from Greenwich, Connecticut, functions as a teaching assistant in the soils testing laboratory (left), and as a graduate student in geotechnical engineering (below). The group is inspecting foundation work for the social sciences building now under construction on the Cornell campus.

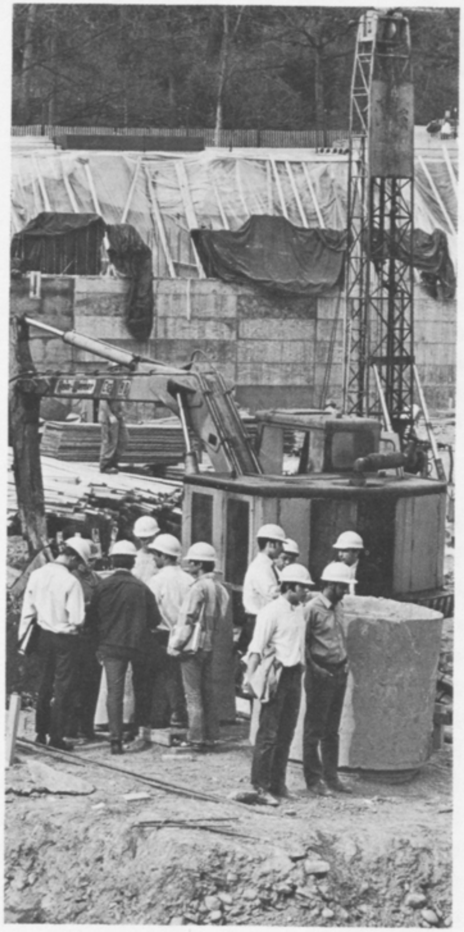
session of his senior year he did some teaching in an elementary school in a ghetto in Baltimore, his hometown. "Only through more and better schooling can the black poor rise in our society," he says, adding that "integration in the schools also seems to be the only effective means of increasing communication between blacks and whites."

The task of locating and designing a new city in the Ithaca–Elmira–Binghamton area of New York state was the project that **William A. Bruno** worked on as part of his Master of Engineering degree requirements. Bill, who is specializing in geotechnical engineering, is preparing for a career in soils and foundations consulting.

The project, supervised by Professor Donald Belcher, was staffed by an eleven-man team of graduate students in structural, environmental, water resources, and geotechnical engineering. Work was begun with a preliminary investigation of the need for a new city to help stop unorganized urban sprawl in the area. The economic feasibility of the proposed city, and its social implications, were also considered. One of Bill's responsibilities was to help choose the site. This involved looking at topographic, soil, and geologic maps, as well as airphotos, to evaluate foundations materials and soil characteristics. From this information the group limited the number of possible sites to eight. Those in the group who were investigating water resources and access to other cities further limited the number of acceptable sites to four. Then a field investigation was made at each of the four sites. The one finally selected has good access to Binghamton and Elmira, an area flat enough to support an eventual population of 30,000, and enough rivers and hills to give variety to the landscape.

This experience helped convince Bill that his specialty of civil engineering is the one that most affects society, providing the "basis for human life—where people live, how they live, and what they see around them."

Photographs for this feature are by David Ruether.



REGISTER

The new director of the School of Chemical Engineering is Kenneth B. Bischoff, who has also been named the Walter R. Read Professor of Chemical Engineering. As director of the School of Chemical Engineering, Professor Bischoff succeeds Charles C. Winding, the Herbert Fisk Johnson Professor of Industrial Engineering, who has completed a thirteen-year term as director and is now beginning his thirty-sixth year of teaching at Cornell. The Register *presents biographical sketches of Professors Bischoff and Winding, and of this year's new and visiting faculty members.*

New involvements in areas such as bioengineering and environmental toxicology are seen for the School of Chemical Engineering by incoming director *Kenneth B. Bischoff*. The present "strong orientation of the School toward instruction and research in industrial problems" should be continued, he believes, and should "hopefully interact with efforts in new directions." He would like to see an expansion of activity in established areas such as kinetics and reactor design, biochemical engineering, and polymer processing and rheology, and in addition, the development of collaborative projects with other groups in the University, both outside and within the College of Engineering.

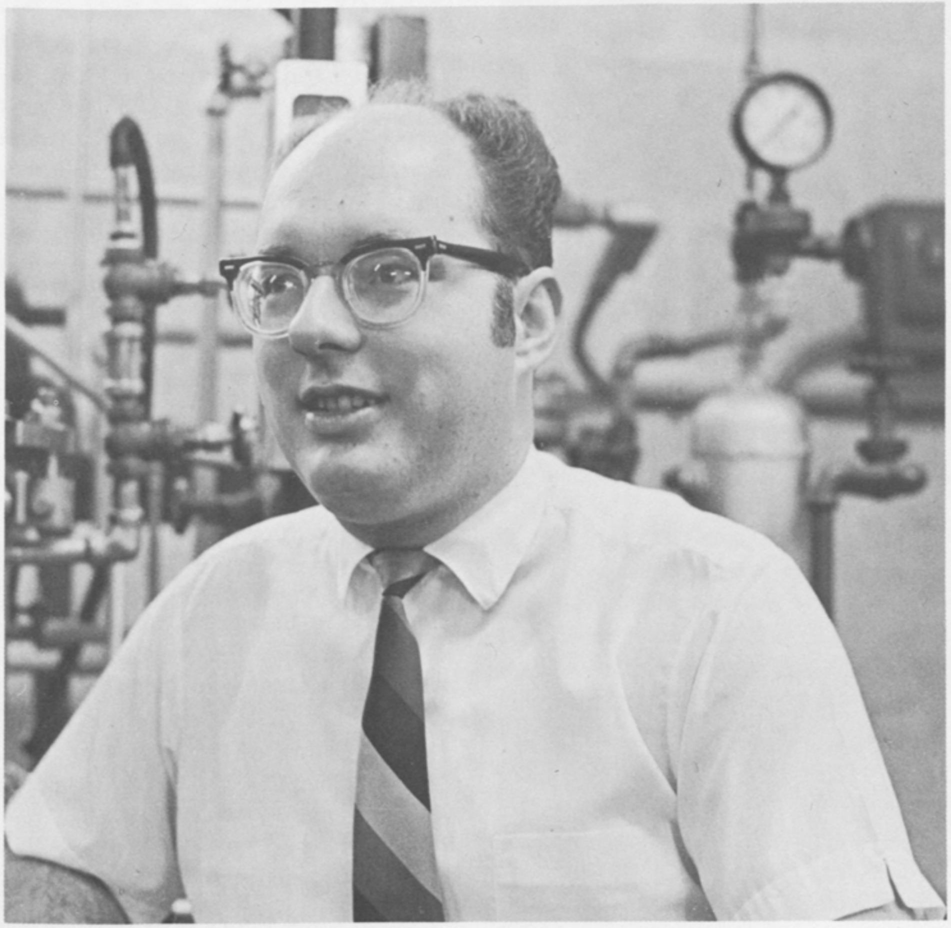
The lines of research that Professor Bischoff himself will direct are suggested by his recent activities. He is currently working with the National Cancer Institute of the National Institutes of Health (NIH) in an effort to apply chemical engineering methods to the problem of mathematically describing the distribution of drugs, in particular "anti-cancer" drugs, in the body. This is an example of the bioengineering approach that Professor Bischoff believes should be more extensively applied to fundamental biomedical and environmental problems.

Kenneth Bischoff brings to Cornell a diversified background which includes nine years of teaching, extensive engineering practice and research, and a long history of participation in professional and public health organizations.

Born in Chicago, Professor Bischoff studied at the Illinois Institute of Technology, where he earned the B.S. degree in chemical engineering in 1957 and the Ph.D. degree in the same field in 1961. In 1960–61 he held a National Science Foundation Postdoctoral Fellowship and lectured at the Universities of Ghent and Brussels in Belgium and at the Technische Höchschule in Darmstadt, Germany. For the next six years he taught at the University of Texas and, most recently, was professor of chemical engineering at the University of Maryland.

Professor Bischoff's research and industrial experience includes summer work with the Bioengineering and Instrumentation Branch of NIH, Esso Research Laboratories, the American Oil Company, and the Natural Gas Pipeline Company of America. He has continued as a consultant to NIH and Esso. He is a registered professional engineer in Texas.

Professor Bischoff is active in many professional organizations. He has been chairman of several specialty conferences for the American Institute of Chemical Engineers, and as its repre-



sentative he served as meeting chairman of the First International Symposium of Chemical Reaction Engineering, which was held in Washington last June. He is a member of the executive committee of the Chemical Engineering Division of the American Society for Engineering Education, and is a member also of the American Chemical Society, the American Society for Artificial Internal Organs, and the American Association for the Advancement of Science.

Other activities include the chairmanship of the planning committee for the Engineering and Urban Health Sciences Study Section of the United States Public Health Service. He is a consultant to the Biomedical Engineering Special Study Section and the Artificial Kidney Contracts Review Group of NIH.

The author of more than fifty papers, many in the field of bioengineering, he has also written, with D. M. Himmelblau, *Process Analysis and Simulation* (John Wiley, 1968) and *Fundamentals of Process Analysis and Simulation* (American Institute of

Chemical Engineers Continuing Education Series, No. 1, 1967). He is currently working on the manuscript of another text, *Chemical Reactor Analysis and Design,* with G. F. Froment of the University of Ghent, Belgium. He has been an editor of two publications of the American Institute of Chemical Engineers: *Case Studies in Process Analysis and Simulation* (1966) and *The Artificial Kidney* (1968).

Professor Bischoff's honors include membership in the New York Academy of Sciences, Tau Beta Pi, Phi Lambda Upsilon, Sigma Xi, and Omega Chi Epsilon. He is a Fellow of the American Institute of Chemists and is listed in *American Men of Science* and *Who's Who in the South and Southwest.*

Professor Bischoff holds the Walter R. Read Professorship of Chemical Engineering. This chair was endowed by Read, a 1915 graduate of Cornell, who is professionally engaged in machine tool manufacturing and real estate management, and by the Ford Foundation.

Charles C. Winding

■ *Charles C. Winding,* who joined the Cornell faculty in 1935, has had a share in the education of all but a few of the College's 1,300 chemical engineering graduates. He has been a full professor since 1944 and was director of the School of Chemical Engineering from 1957 to 1970, when he returned to full-time teaching.

Professor Winding was educated at the University of Minnesota, from which he received the B.Ch.E. degree in 1931 and the Ph.D. degree in chemical engineering in 1935. He has been a consultant for the Tide Water Associated Oil Company, the Rubber Reserve Company, the B. F. Goodrich Company, and the Rome Cable Corporation. From 1958 to 1968 he was associated with the Cowles Chemical Company as a consultant and a member of the board of directors. His fields of interest include adsorption, heat transfer, fluid flow, and polymerization and polymeric materials. Among his publications are two books: *Plastics, Theory and Practice* with R. L. Hasche (McGraw-Hill, 1947) and *Polymeric Materials* with G. D. Hiatt (McGraw-Hill, 1961).

Professor Winding is a member of the American Institute of Chemical Engineers, the American Chemical Society, the American Society for Engineering Education, and the Society of Plastics Engineers. He has served on a number of special committees and boards of these organizations. He is a Fellow of the American Institute of Chemists and holds memberships in the honorary societies Tau Beta Pi, Sigma Xi, and Phi Lambda Upsilon. He is listed in *American Men of Science* and *Who's Who in America.*

■ *Philip L. Bereano,* assistant professor of environmental systems engineering, has professional training not only in regional planning, but also in law. He holds the J.D. degree *cum laude* from Columbia University (1965) and is to receive the M.R.P. degree from Cornell in January. He received his undergraduate degree in chemical engineering from Cornell in 1962. At the present time Professor Bereano is a member of the steering committee of the Cornell University Program on Science, Technology, and Society, the administrative board of the Cornell Human Affairs Program, and the University Committee on Campus Planning. He is active in the local Office of Economic Opportunity agency, serving as a member of the board of directors and chairman of the legal services committee; and he is a member of MOVE, a community action group in Ithaca. Professor Bereano, who was admitted to the bar in New York State in 1965, has worked as an associate attorney with Cooper, Dunham, Henninger and Clark; and with the National Air Pollution Control Administration of the United States Public Health Service as legislative assistant working in Congressional liaison and as a trainee in regional planning. Professor Bereano is a member of the Environmental Defense Fund, Urban America, and Tau Beta Pi.

■ *Walter H. Bray* comes to Cornell as assistant professor of engineering after having taught last year at Stanford University, where he received his graduate education. He was awarded the M.S.C.E. degree in 1961, the degree of Engineer in 1965, and the Ph.D. degree in civil engineering in 1969. He studied at Union College for his B.C.E. degree, awarded in 1958. A specialist in soils and cement technology, Professor Bray has had engineering experience with the New York State Bureau of Soil Mechanics, Mission Engineers, and Cotaldo and Vitre, and as a highway engineering trainee with the United States Bureau of Public Roads.

■ *Brendan S. K. Chang,* assistant professor of electrical engineering, was born in Szechnan, China, and received his B.S. degree in electrical engineering from National Taiwan University in 1965. He came to the United States for graduate training in the same field and received the M.S. degree in 1967 and the Ph.D. degree in 1969 from the University of California at Berkeley. Before coming to Cornell, Professor Chang served as a research member in image processing at the International Business Machines Watson Research Center, and he has published several papers in this field. He is a member of the Association for Computing Machinery and the Institute of Electrical and Electronics Engineers.

■ *Christian T. Dum,* assistant professor of applied physics, was born in Austria and received his initial education there. He holds a Diploma in applied mathematics (1963) and an Engineering Diploma in physics (1964) from the Institute of Technology in Vienna. He also took supplementary courses at the University of Vienna. His Ph.D. degree in physics was awarded by the Massachusetts Institute of Technology in 1968. Since then he has been at Cornell as research associate in the Laboratory of Plasma Studies, and as instructor in electrical engineering. During the summer of 1970 he participated in the Plasma Workshop at the International Centre for Theoretical Physics, Trieste, Italy. Professor Dum has had experience with major companies in Switzerland, France, Germany, and Austria in the fields of electrical installations and power supply, UHF and TV electronics, and telecommunications systems. He received a Fulbright travel grant and, as a graduate student at M.I.T., he held research and teaching fellowships. He is a member of Sigma Xi and the American Physical Society, and has published a number of papers, mostly in the area of plasma studies.

■ *Jeffrey Frey,* assistant professor of electrical engineering, is returning to his undergraduate college and department after graduate studies at the University of California at Berkeley, where he received the M.S. degree in 1963 and the Ph.D. degree in 1965, both in electrical engineering. While still a graduate student, he gained industrial experience in summer work with the Hughes Research Laboratories, and after receiving his doctorate he worked with the Watkins-Johnson Company as a member of the technical staff. He later worked in England as a NATO postdoctoral fellow at the Rutherford High Energy Laboratory, and as a research associate at the United Kingdom Atomic Energy Research Establishment. While in England he attended the Culham Laboratory Summer School in Plasma Physics. Professor Frey's research interests include high-density electron and ion beams and microwave semiconductors. He has published a number of papers in these fields. He is a member of Eta Kappa Nu, Tau Beta Pi, Phi Kappa Phi, and Sigma Xi.

■ *Frederick C. Gouldin,* assistant professor of thermal engineering, received both undergraduate and graduate degrees from Princeton University: the B.S.E., with high honors, in aerospace and mechanical sciences, in 1965, and the Ph.D. in 1970. During his graduate years he held a NASA trainee fellowship and a Guggenheim fellowship. He has had summer research experience in computer programming at the Naval Research Laboratory, and in the combustion laboratory of Atlantic Research Corporation. Professor Gouldin's specialty is combustion processes; his Ph.D. thesis was concerned with temperature measurement in metal diffusion flames. He is a member of the American Institute of Aeronautics and Astronautics, Combustion Institute, American Association for the Advancement of Science, and Sigma Xi.

■ *Ellis Horowitz,* assistant professor of computer science, did his graduate work in this field at the University of Wisconsin, receiving the M.S. degree in 1967 and the Ph.D. degree in January of this year. Last year he was assistant chairman and instructor of computer science at Wisconsin. His B.S. degree in mathematics was awarded by Brooklyn College in 1964. Professor Horowitz was a National Science Foundation research fellow in 1968–69, and he held a three-year New York State college teaching fellowship. He is a member of the Association for Computing Machinery and of Sigma Xi.

■ *David M. Jackson,* a British citizen, is assistant professor of computer science. He was educated at Trinity College, Cambridge University, from which he received a B.A. degree in mathematics in 1964, a diploma in numerical analysis and computing in 1965, and a Ph.D. degree in mathematics in 1969. He came to the United States as a senior visiting research associate at Ohio State University and last year was assistant professor of computer and information science there. He is a member of the Classification Society, the British Computer Society, and the Pattern Recognition Society, and has written a number of articles on topics related to these fields.

■ *Walter H. Ku,* associate professor of electrical engineering, came to Cornell last year as a visiting associate professor after seven years of service as a senior scientist with the Applied Research Laboratory of Sylvania Electronic Systems. During that time he was also a lecturer in the Graduate School of Northeastern University where he taught courses in network synthesis and optimal estimation and control. Professor Ku was born in Peiping, China, but received his academic training in the United States. He received the B.S. degree in electrical engineering, with honors, from the University of Pennsylvania in 1957, and the M.S. and Ph.D. degrees in electrical engineering from Polytechnic Institute of Brooklyn in 1958 and 1962. During his last two years at Polytechnic, he was associated with the network theory group of the Microwave Research Institute, where he conducted full-time research in the areas of network synthesis, stability of active networks, and varactor parametric amplifiers. In addition to his work at Sylvania, Professor Ku has had industrial experience in summer work with the IBM Product Development Laboratory and with Vitro Electronics. He is a member of Sigma Xi, Sigma Tau, Eta Kappa Nu, Tau Beta Pi, the Society of Industrial and Applied Mathematics, and the Institute of Electrical and Electronics Engineers. His field of interest is network and system theory with emphasis on advanced synthesis techniques, stability, and microwave solid-state devices.

■ *Jorge J. Moré,* a native of Cuba, received his Ph.D. degree in applied mathematics from the University of Maryland last June, became a citizen of the United States in July, and joined the Cornell faculty as assistant professor of computer science in September. He received his B.S. and M.S. degrees in mathematics from the Georgia Institute of Technology in 1966 and 1968. Professor Moré was a graduate research assistant at Maryland, and wrote his thesis on nonlinear functions. He is a member of the American Mathematical Society and the Mathematical Association of America.

■ *Charles K. Paul,* assistant professor of engineering, completed the work for his Ph.D. degree in civil engineering at Cornell in June of this year. He received his B.S. degree in 1961 from the University of New Mexico and the M.S. degree from Cornell in 1967. Professor Paul has had experience in the fields of geodesy, oceanography, deep ocean engineering, and space science (as photoscientist) with the Coast and Geodetic Survey, the Naval Civil Engineering Laboratory, and the Jet Propulsion Laboratory. As a Cornell graduate student he served as a research assistant in the Newman Laboratory of Nuclear Studies, as teaching assistant in surveying, and as a NASA trainee in mechanical systems and design. He is a member of Chi Epsilon, Sigma Xi, and the American Society of Photogrammetry.

■ *Teoman Peköz,* assistant professor of structural engineering, received his Ph.D. degree in this field from Cornell in 1967 and subsequently was a senior staff engineer at Raytheon Company. Born in Turkey, Professor Peköz studied as a Fulbright scholar and earned a B.S. degree in civil engineering in 1958 from Robert College, Istanbul, Turkey. He began graduate studies at Harvard University as a Gordon McKay Fellow and received the M.S. degree in structural engineering and soil mechanics in 1959. In 1961 he was drafted into the Turkish Army and served as an army engineer. Professor Peköz's teaching experience includes assistantships at Cornell and Harvard and a year as instructor at the Middle East Technical University in Ankara, Turkey. His industrial experience has been as a structural designer and consultant for various companies. He is a member of the American Society of Civil Engineers.

■ *Wolfgang H. Sachse,* assistant professor of theoretical and applied mechanics, completed graduate work at Johns Hopkins University last year and spent a year as a Deutscher Akademischer Anstauschdienst Fellow at the Institut für allgemeine Metallkunde und Metallphysik in Aachen, Germany, before coming to Cornell. His B.S. degree in physics was awarded in 1963 by Pennsylvania State University, where he also worked as a technician in the Crystal Research Laboratory and as a summer research assistant in the Materials Research Laboratory. A specialist in experimental mechanics, Professor Sachse has published a number of papers in the areas of crystal deformation and plastic properties of metals. He has held National Aeronautics and Space Administration and Kennecott Copper Company fellowships, and was awarded a Sigma Xi research grant-in-aid. He is a member of the American Institute of Mining, Metallurgical, and Petroleum Engineers, the Maryland Institute of Metals, the Society of Natural Philosophy, and Sigma Xi.

■ *Dwight A. Sangrey,* who received his Ph.D. degree in civil engineering from Cornell in 1967, is returning as associate professor of geotechnical engineering after spending three years at Queen's University at Kingston, Ontario, as an assistant professor. He received the B.S. degree in 1962 from Lafayette College and the M.S. degree in 1964 from the University of Massachusetts, both in civil engineering. Professor Sangrey has had industrial experience with Shell Oil Company as field and project engineer specializing in offshore marine structures and foundations, and with H. L. Griswold Associated Civil Engineers as a general consultant. He is a member of the American Society for Testing and Materials, and received a research grant-in-aid award from this organization in 1969. He is also a member of the American Society of Civil Engineers, the International Society for Soil Mechanics and Foundation Engineering, and the Association of Professional Engineers of the Province of Ontario. His published work is in the general area of soil engineering.

■ *Kuo-King Wang* brings to Cornell the experience of many years of diversified work in industry, as well as a background in engineering teaching. An authority in the manufacturing processes field, he is associate professor of mechanical systems and design. Professor Wang holds a B.S. degree in mechanical engineering from National Central University in China, his native country; and M.S. and Ph.D. degrees, also in mechanical engineering, from the University of Wisconsin. He was employed by shipbuilding companies in Taiwan for thirteen years following his undergraduate education, serving as construction supervisor, machine shop superintendent, plant and design engineer, and supervisor in the planning and scheduling, and in the production and control departments. In 1960 he came to the United States to begin graduate study at Wisconsin, and received his master's degree in 1962. From 1962 to 1966 he was a project engineer with the Walker Manufacturing Company. After receiving his doctorate in 1968, Professor Wang taught at Wisconsin as instructor and then assistant professor of mechanical engineering.

■ *Thomas R. Wilcox,* instructor of computer science, expects to complete studies for his Ph.D. degree at Cornell in February, 1971. He has been a graduate student at Cornell since 1967, and received the M.S. degree in computer science last year. He has served as a teaching assistant and has held a three-year National Aeronautics and Space Administration traineeship. Mr. Wilcox received his B.S. degree with high distinction and high honors in mathematics from the University of Michigan in 1967. He has had professional experience in programming in summer work with the Eastman Kodak Company and as a part-time programmer for radio-chemistry projects at the University of Michigan. He is a member of the Association for Computing Machinery.

■ *John H. Williams,* assistant professor of computer science, earned all three of his academic degrees—the B.S. in mathematics in 1962, the M.S. in mathematics in 1963, and the Ph.D. in computer science in 1969—from the University of Wisconsin. Subsequently he joined the faculty there as assistant professor of computer science. His experience also includes summer work as a mathematician for the Lawrence Radiation Laboratory.

The following are visiting faculty members in the College of Engineering for the academic year 1970–71.

Alan J. Bennett, visiting associate professor of applied physics, is a physicist with the General Electric Research Laboratory. His specialty is surface physics.

Israel Cederbaum, visiting professor of electrical engineering, is a professor at Technicon — Israel Institute of Technology.

Steven Fenves, visiting professor of civil engineering, is a specialist in computer applications and structural engineering. He is professor of civil engineering at Coordinated Science Laboratory, University of Illinois.

Walter I. Goldburg, visiting professor of applied physics, is a professor of physics at the University of Pittsburgh. His fields of interest include nuclear magnetic resonance.

Ralph E. Gomory, appointed by Cornell this year as an Andrew D. White professor–at–large, is a specialist in integer programming, and will be associated with the Department of Operations Research. He is a member of the Corporate Technical Committee of International Business Machines (IBM) Headquarters, Armonk, and is an IBM Fellow.

Robert L. Smith, visiting associate professor of electrical engineering, is a research physicist at Stanford University. He is a specialist in space plasmas and Whistler phenomena.

FACULTY PUBLICATIONS

The following publications and conference papers by faculty members and graduate students of the Cornell College of Engineering were published or presented during February, March, and April 1970. The names of Cornell personnel are in italics.

■ AGRICULTURAL ENGINEERING

Levine, G. 1970. The water environment and crop production. Paper read at Cornell Workshop on Some Emerging Issues Accompanying Breakthroughs in Food Production, 30 March–3 April 1970, Cornell University, Ithaca, New York.

Spencer, J. W. 1970. New highway training program. Paper read at Annual Meeting of Association of Towns, 9–11 February 1970, New York.

———. 1970. Some observations on bituminous surface treatments. Paper read at Second Annual Meeting of North Atlantic Applicators Association, 2 April 1970, New York.

■ APPLIED PHYSICS

Andrews, M. L., Davitian, H., Hammer, D. A., *Fleischmann, H. H., Nation, J. A.,* and *Rostoker, N.* 1970. On the propagation of high-current beams of relativistic electrons in gases. *Appl. Phys. Letters* 16:98–100.

Buhrman, R. A., Halperin, W. P., Reppy, J. D., Richardson, R. C., Schmenterly, S. W., and *Webb, W. W.* 1970. Superconducting quantum interference nuclear thermometer. Paper read at Symposium on Ultra-Low Temperatures, 23 April 1970, Washington, D.C.

Burns, S. J., and *Webb, W. W.* 1970. Fracture surface energies and dislocation processes during cleavage of LiF: Part I, Theory, and Part II, Experiment. *J. Appl. Phys.* 41:2078–85 and 2086–95.

Hanson, R. C. 1970. Diffusion of lithium in potassium chloride. *Phys. Stat. Sol.* 1:109–13.

Holmes, C. P., and *Kostroun, V. O.* 1970. L subshell fluorescence yields and Coster-Kronig transition probabilities for Ho and Er. Paper read at Spring Meeting of the American Physical Society, 26–30 April 1970, Washington, D.C.

Kime, M. B., and *Clark, D. D.* 1970. Decay of 11-msec Sm-153m. Paper read at Spring Meeting of the American Physical Society, 26–30 April 1970, Washington, D.C.

Liboff, R. L. 1970. Fields due to a relativistic particle in a grounded cylindrical box. Talk given at School of Engineering and Applied Science, Columbia University, 27 February 1970, New York.

Nation, J. A. 1970. High current relativistic electron beams; Enhanced microwave emission and beam transport. Paper read at Spring Meeting of the American Physical Society, 26–30 April 1970, Washington, D.C.

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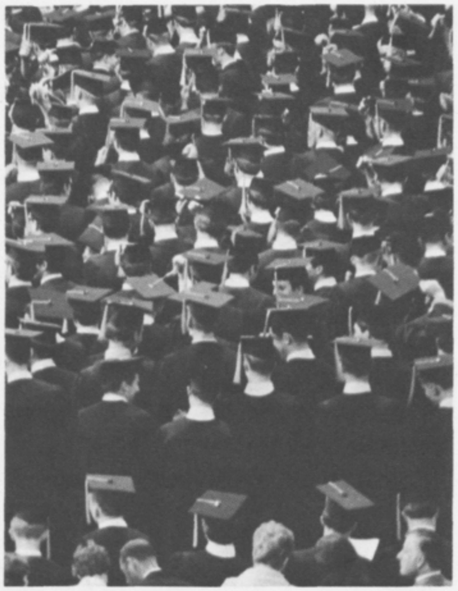

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"Why do you want to be an engineer?" "Because I enjoy and do well in math and science." So go thousands of interviews between student visitors and admissions officers throughout the country. That there is an insufficiency of student response poses a truly perplexing problem first to admissions men and then to educators. How can they be sure that the right candidates are being chosen for the right reasons? Are they perhaps asking the wrong questions? Too often admissions decisions have relied on the apparently "safe" procedure of picking the most scholastically able candidates on the grounds that they can "handle" the degree program.

What should really count? First, does an applicant have that indefinable spark of inquisitiveness or ingenuity that distinguishes him from "book-bright" students? Does he believe in what he is and hopes to be doing? Does he have the mental stamina which will sustain him if and when the going gets rough? In short, will he stay "turned on" after beginning his undergraduate education? And the most important question of all is also the toughest: what promise of long-range professional excellence and leadership is present in that 17- or 18-year-old sitting across the desk from the admissions officer? Should questions like these be considered? Is there any evidence that they can be answered?

Applicants could be better assessed on many of these rather subjective points if they came to their interviews with a more concrete idea of engineering education and practice. The 60's was a period of unprecedented change in the education of engineers, and in their professional prospects. In most schools, course work now emphasizes the fundamental and the conceptual aspects of knowledge; state-of-the-art courses and associated laboratories have generally disappeared. Graduate study boomed and diverted the attention of faculty members from undergraduates alone to both graduate and undergraduate students. New areas and careers have opened to engineering graduates—whole new technologies have emerged. And there is growing promise of much stronger "human interaction" in the work of practicing engineers in the 70's. But does an awareness of these rather pronounced changes filter through to the secondary school student body, faculty, and staff? Should we expect students to form a reasonably accurate idea of what engineering is all about?

Unfortunately, the most imaginative, creative, and exciting engineers are not always the spokesmen for the profession. As educators seek tomorrow's engineers, there is great need for more effective, more imaginative, and more exciting input from those "men of action" who can speak from their experience and at the same time can excite and stimulate those students who have the subtle qualities needed to make outstanding professionals.

THE EDITOR