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VOL. 73, NO. 2 MEMBER ECMA 35 CENTS NOVEMBER 1968

wisconsin engineer

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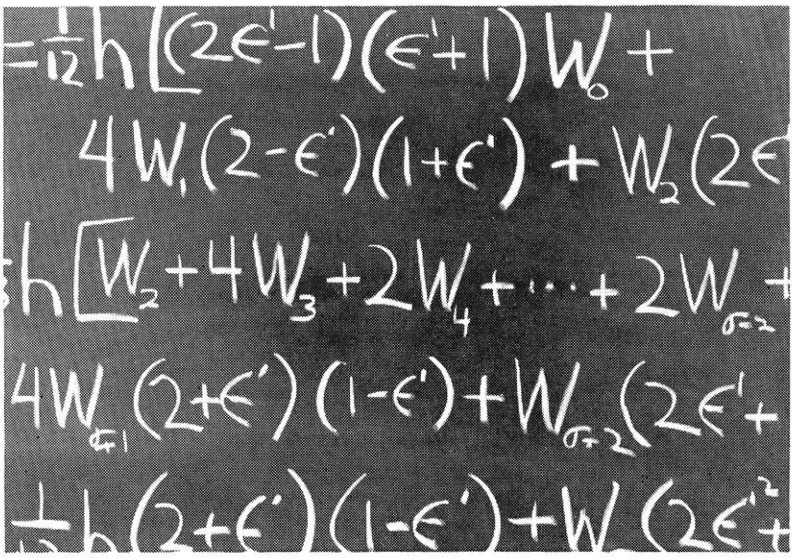
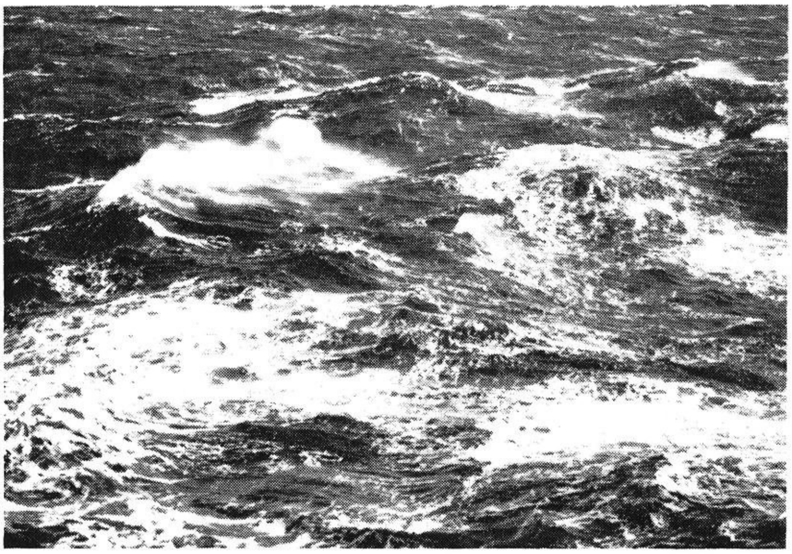


or knowledge of oceans.



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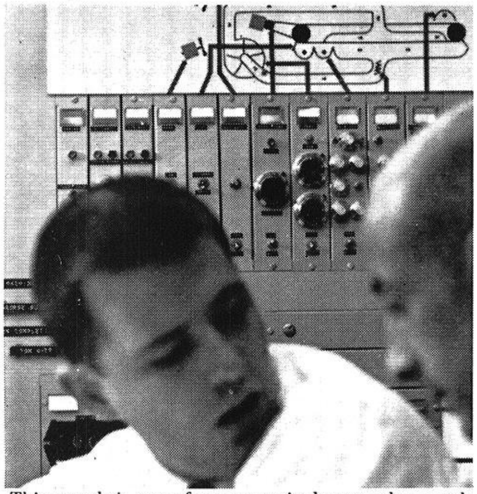

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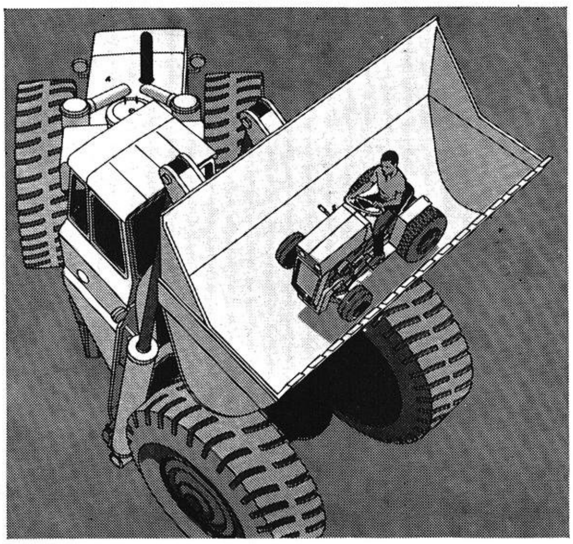

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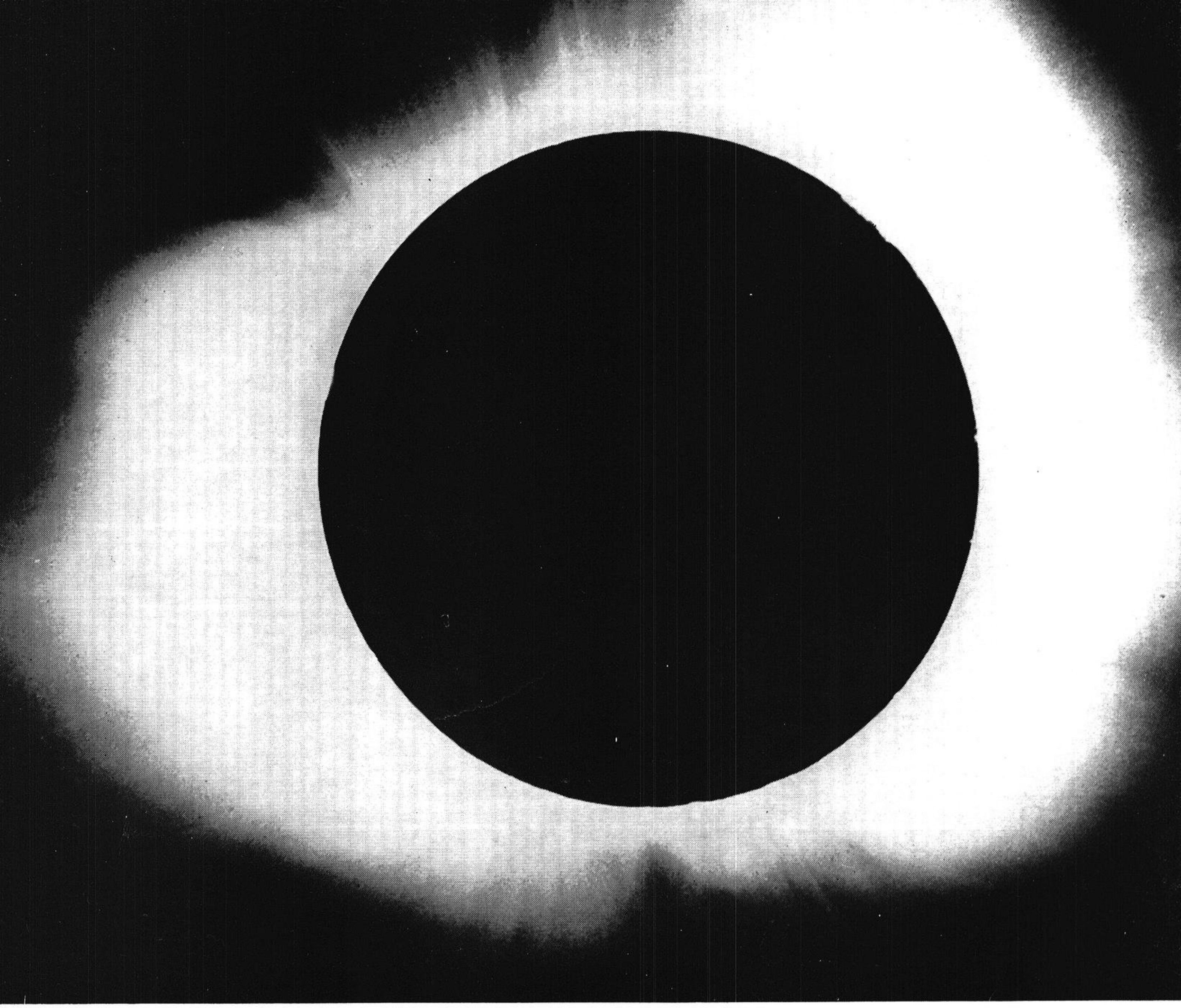


On the Joke Page

by Eric Fonstad

Yes, Virginia, there is a joke page. Under threat of being excommunicated from the College of Engineering, the *Wisconsin Engineer* has decided to print a joke page in this issue. The following letter is one reason for this decision:

October 18, 1968

Dear Sir:

Glancing at this year's first issue of the Wisconsin Engineer *this morning, I was disappointed not to find the familiar joke page. For those of us who are not in the College of Engineering (I am in Letters and Science) the opportunity to chuckle at a few comic lines provides a hearty relief from the confusion of technical articles and the Fall Interview Date Schedule. In response to Eric Fonstad's question on the final page, "Do you feel like you're missing something?" I would like to submit that I am — THE JOKE PAGE!*

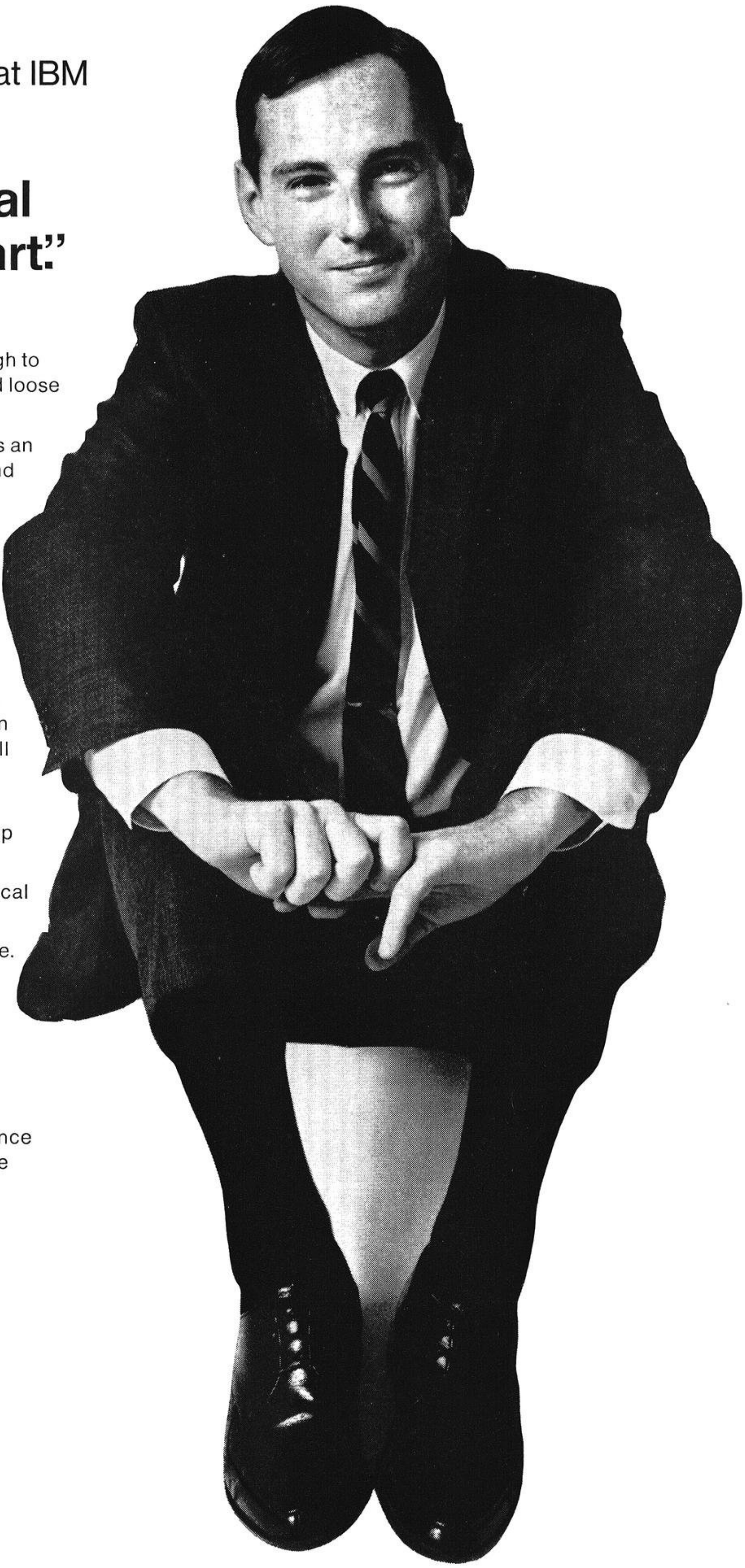
Sincerely,
Cordelia Ryan
2203 Elizabeth Waters

Cordelia wasn't the only person to notice that the jokes were missing, though she was the only one to put her objections in writing. Many others found out that there was no joke page planned for the October issue even before the first copies of the magazine were on the stands. With almost ritual-like regularity these people corner members of the magazine staff about two weeks before the next issue is due to be distributed and with their elbows nudging the other's ribs, demand; "You got any good jokes in there this time?" The emphasis is on "good" jokes. This time, when the answer came that there would be no jokes whatsoever, they simply glared in disbelief and disappointment.

Since the magazine has been out, I have watched many engineers pick up a copy, thumb through the back pages, and then announce to all within hearing distance, "There ain't no joke page" or simply "no jokes." In a tone of voice suggesting that the *Wisconsin Engineer* had committed some terrible crime against all engineers, they would then demand an explanation. Still, for all the verbal grumbling, only one letter was sent to the editor and that one wasn't even from an engineer.

The magazine has also received comments that have suggested that the joke page was always the poorest part of the magazine and that no one would miss it if it were permanently dropped. A typical example is the comment from Erhardt C. Koerper, a former college editor himself and now president of Koerper Engineering Associates, Milwaukee. In a letter received by the magazine last spring, he writes, "Your joke page gives the impression of being crude which trades down the otherwise fine quality of your publication." The magazine staff is very much concerned about producing a fine quality magazine. How concerned are you about retaining the joke page? Stated more simply, if the editorial staff does not receive written encouragement to print a joke page, this month's version could be the last.

Paradoxically, a survey that the *Wisconsin Engineer* took last April showing that the joke page was the most popular feature of the magazine is one reason justification for printing a joke page has been questioned. Although its high popularity indicates to us that the joke page has attracted readers, it also brings to mind an article by Paul T. Bryant of the Department of English at Colorado State University. In it he states, "The student engineering magazine cannot successfully be either a joke book or a 'girlie' magazine. If student readers look only at the joke page, the magazine is not accomplishing much." The staff of the *Wisconsin Engineer* feels that it can accomplish much by serving as a communications vehicle between the engineering student, his faculty, and those people who feel engineers are out of touch with the world who may simply be out of touch with engineers. We also feel that the magazine can serve as a forum for discussing both technical and social engineering problems and that it can be entertaining without being crude.



Engineers Cool on 'Girl of the Month'

Printed here are the results of the questionnaire card which was enclosed in last April's issue of the *Wisconsin Engineer*. Again, we are asking you to check the areas that you have interest in and the features that you enjoy. Last time we received many cards from electrical engineers who did not enjoy having their department left off the list of "areas of interest."

The most interesting cards we received were those which had comments about what type of articles the *Wisconsin Engineer* should contain. One twenty-year-old chemical engineer urged us to "Keep politics out. If a person wants politics, one 'Daily Cardinal' will keep him satisfied for a month," while a twenty-two-year-old electrical engineer maintained, "It would be interesting to see the *Wisconsin Engineer* discuss some social and world problems."

Our response to these comments is that the *Wisconsin Engineer* tries to assume the personality of the students it represents and will be active or passive toward social and political issues in relation to the feelings of those students. The staff agrees with the suggestion of another reader that "The *Wisconsin Engineer* could provide a valuable service by giving the engineer a forum to discuss and evaluate areas of concern."

Since these results are perhaps already a little out of date, we are asking you to help us again by filling out this revised card. We want our magazine to be as responsible to its readers as possible, but we need communication from you in order to accomplish this. Please help us by filling out the enclosed card and either mailing it to us, leaving it in one of our campus boxes, or in our mail-box.

Should We Continue?	YES	NO
Technical Stories	23	
Joke Page	25	1
Feedback	11	
Editorial	20	
Brain Teasers	15	
Album	10	1
College History	13	
Campus Articles	14	
Polygon Board	12	
Girl of the Month	1	1

Would You Like to See Articles On?	YES	NO
Campus Politics	8	3
City Problems	10	2
Engineering Library	5	
Curriculum	19	
Critique Professors	13	
Jobs and Salaries	22	
Alumni	10	1
Industry	22	
TA System	6	1
Summer Opportunities	1	
Scholarships	1	

Areas of Interest
(all votes are positive for this section)

Space	16
Aeronautics	14
Automotive	8
Biomedical	10
Civil Engineering	5
Mechanical Engineering	5
Mining and Minerals	3
Chemical Engineering	7
Research	13
Nuclear Engineering	6
Engineering Mechanics	3
Industrial Engineering	3
Engineering Management	1
Applications of Engineering	1
Electrical Engineering	4
Instrumentation	1
Ingenious Devices	1
Oceanography	2
Physics	1
Computers	1

A Case for a National Primary

". . . The Convention, imperfect organ of representative government as it is, is an essential part of the American system. It has rendered far more good service than it has done harm and no really effective substitute for it has ever been suggested . . ."

D. W. Brogan

"Political conventions represent more wasted energy, more futile fruitless endeavor, more useless expenditure of noise, money, and talent than any institute on earth."

Irvin S. Cobb

"Now, through complacency and apathy we wander about in Pogo's swamp. Too often our responses to issues lag behind to become ineffective rhetoric. Rise to meet the challenge. Get off your soft rear and do something."

Daniel P. Connley

Perhaps you were among those who went to the polls last November 5th bewildered and confused. Certainly the choice of preselected candidates did little to lessen your anxieties. In principle, those candidates and their respective platforms — representing this country's foremost political personalities and policies — should have been intelligently choosen by convention delegates.

So, on November 5th you looked at the names of Humphrey, Nixon, and Wallace. The first two seemed to offer little choice while the third is a "former" racist. Perhaps you looked at the names again and thought, "with a clear conscience I can't really bring myself to support any of them."

There is a solution. With some basic and uniform changes, the voter could once again be in charge of choosing our national candidates and policies.

- ☐ A national primary to be held in July or August. Candidates would need to obtain in the form of a petition a certain percentage of the state's eligible voters to be placed on the ballot.
- ☐ Those to be placed on November's national ballot would need at least 5% of the total vote cast in the primary election.
- ☐ In the national primary election delegates to party conventions would also be elected in a manner suitable to each party.
- ☐ When two or more candidates from the same party enter and neither wins an absolute majority, then a run-off election would follow as soon as possible, allowing any voters with that particular party affiliation to vote in the run-off.
- ☐ Delegates would assemble at convention sites in early October to decide on party platforms.
- ☐ The national election would be held in November. If there happened to be no absolute majority then a run-off of the top two contenders would follow as soon as possible.

A recent Harris poll shows voter opinion favoring some sort of national primary. All the movement needs is the support of those this change will help the most. And that is you.

Dan Connley

Be frustrated. As only a participant can be. ☐ We'll give you every opportunity to participate. To stretch your mind. To struggle with a problem until you get mad. Until you solve it. And get the credit you deserve. ☐ We don't promise the world. Or the moon. Just the satisfaction of using your talents. Day after day. ☐ Whether you're in research and development, marketing, refining, planning and engineering, or administration. ☐ Your pencils are waiting. ☐ **That's what we promise. If it's enough, talk to our representative on your campus. See our ad on the next page for the date.**

STANDARD OIL DIVISION
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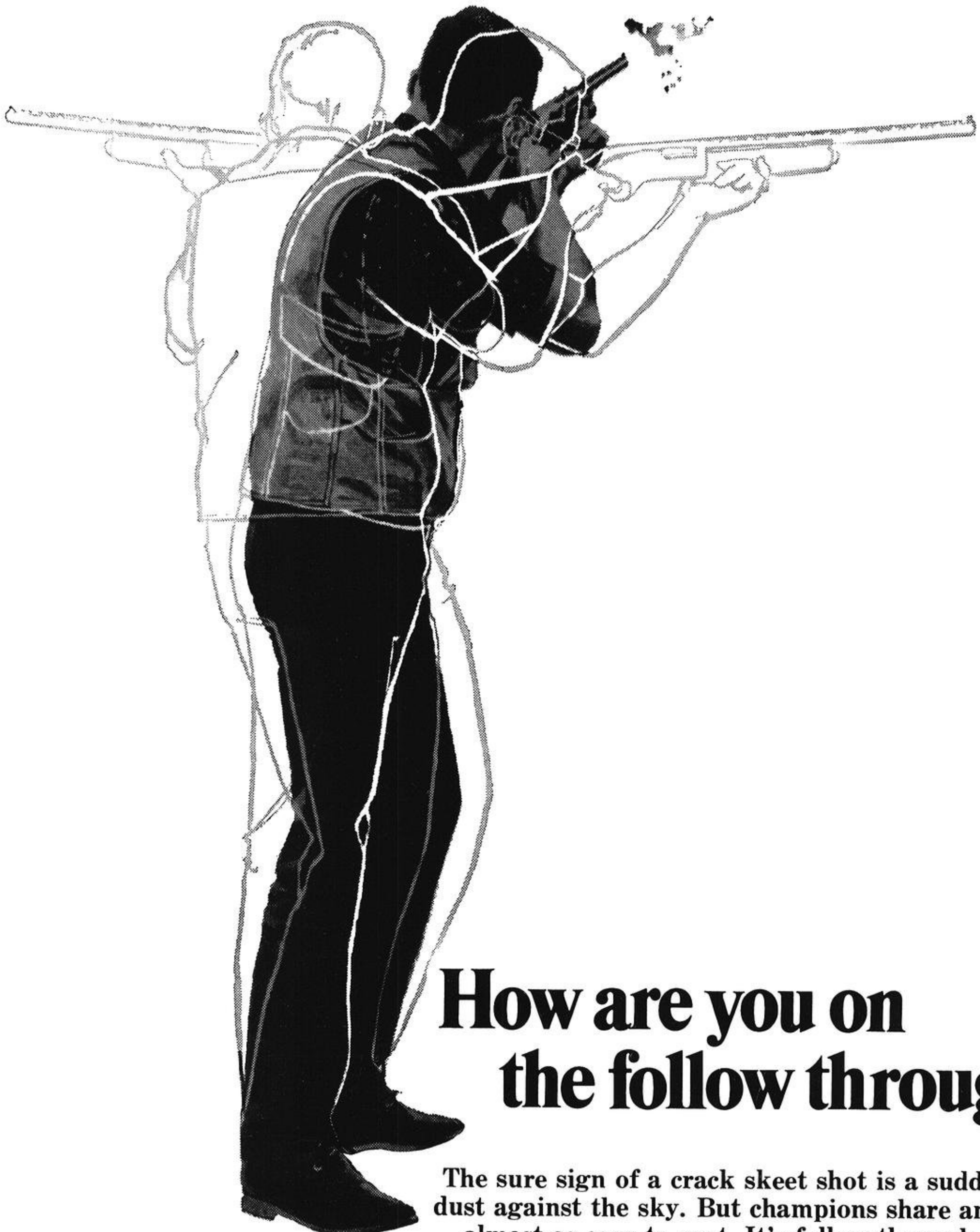
Come with us and be fulfilled.



THE HILL AND THE ENGINEER

Johnson Street appears to be doing more than move traffic along toward the Square. It is apparently serving as a "buffer zone" between the Hill Student and the Engineer, his valley counterpart. Above the din of the moving cars can be heard the cries of, "you dirty hippies", "Vietniks", and "Commies" coming from one side. Answering these are the protesting cries of, "lousy straights", "war-mongers", and "Red-baiters". In all, it is a most unpleasant situation, and one which has served to divide badly the students of this campus. It is not all politics and clothes, as many would like to believe, and there is both fact and fiction in the ideas we have conjured up about each other, as the following articles are intended to show.

Reflections on the Engineer

by a philosophy student
(name withheld at author's request)

Engineering students are dedicated and hard-working bores. They rarely think about art, literature or contemporary social problems. Most do not read, or desire to read, newspapers, magazines or books outside their technical area of study. The few who read such material read only the "establishment" press. They haven't time to read more, and "anything else is pretty much nonsense anyway."

The engineering student is, and views himself as, a trainee for a specific sort of job within a limited technological framework. This narrow conception of himself is reflected in his social life, in which he associates almost entirely with people in his special branch of study. The girls he dates must not be very questioning and must view Science with awe. They are in such diverse fields as Home Ec, Nursing and Related Arts.

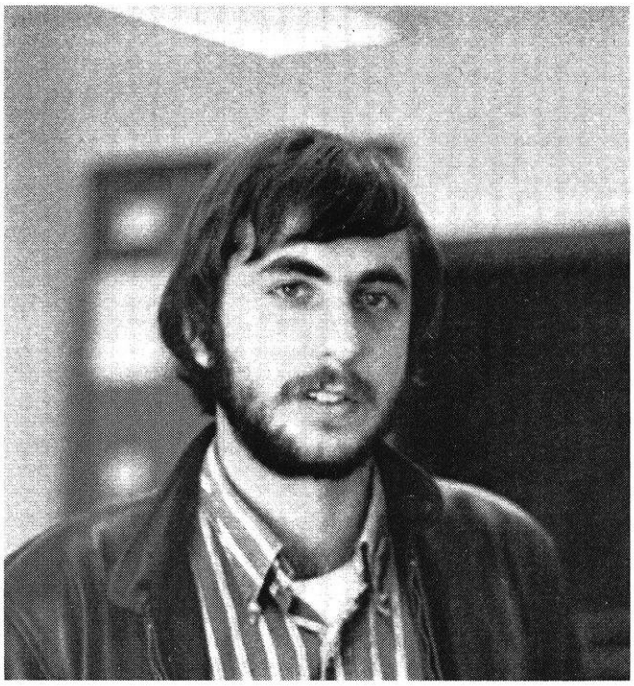
An affirmative answer to the question, "Is the training I am getting sufficient to guarantee me a secure place in some firm after graduation?" is his sole criterion of success as a University student. Consequently, he regards discussion critical of the current corporate structure of America as somewhat irrelevant, if not subversive. Filling a well-paying slot of responsibility within the structure is his goal ("isn't it everybody's?"). Tinkering with the system would imperil his chances of attaining his goal. Therefore he views such tinkering unfavorably, and talk about such tinkering as irresponsible. For, besides his notion of what is and is not in his self interest, he regards most critics of the status quo as naïve. He is convinced that if social problems are amenable to solution, they surely require the expertise of the engineer and are soluble only by technological improvements. As far as he is concerned, "improvement" (if it means anything at all) means increased efficiency and more of what we have now.

In short, "improvement" is a quantifiable notion — or else it is nonsense. He is enforced in his belief by his daily curriculum, his professors, and his carefully chosen friends. If by chance he encounters someone proposing different criteria for improvement, he will meet such proposals suspiciously and unsympathetically. "Your suggested refinements are too subtle for me," he will say, in a self-congratulatory tone. He is convinced that the alleged subtlety of the liberal arts student is a mask for the latter's self-deception. After all, he will think, it is the engineer who is responsible for social change and improvement. The liberal arts graduate can only talk. But talking does not get bridges and stuff constructed. Sophisticated arguments about alternatives for structuring society are ineffective and, consequently, pointless. The liberal arts student does not really understand today's world and its real problems. So whatever he says, and especially when it relates to questions of value, can and should be dismissed as pitiful and irresponsible whistling in the dark.

The cycle of inexposure to views critical to the status quo, defining goals in terms of the status quo, and rationalizing criticism of those goals by labeling them irresponsible — this cycle is self-supporting and vicious. In short, the engineering student is trapped in an hermetically sealed existence and entirely unaware of the trap. He no doubt gets trained to do something, but he does not get an education. Indeed, because of its pragmatic and narrow focus, his training is incompatible with what advanced education should be. The tragedy is that, for him, the question "What should be the goal(s) of advanced education?" is not even open for debate. For it's unlikely to have the sort of neat answer that "real" or "important" questions *must* have.

The Liberal Faction

by Jim Zerbe, Agr4 and ME4



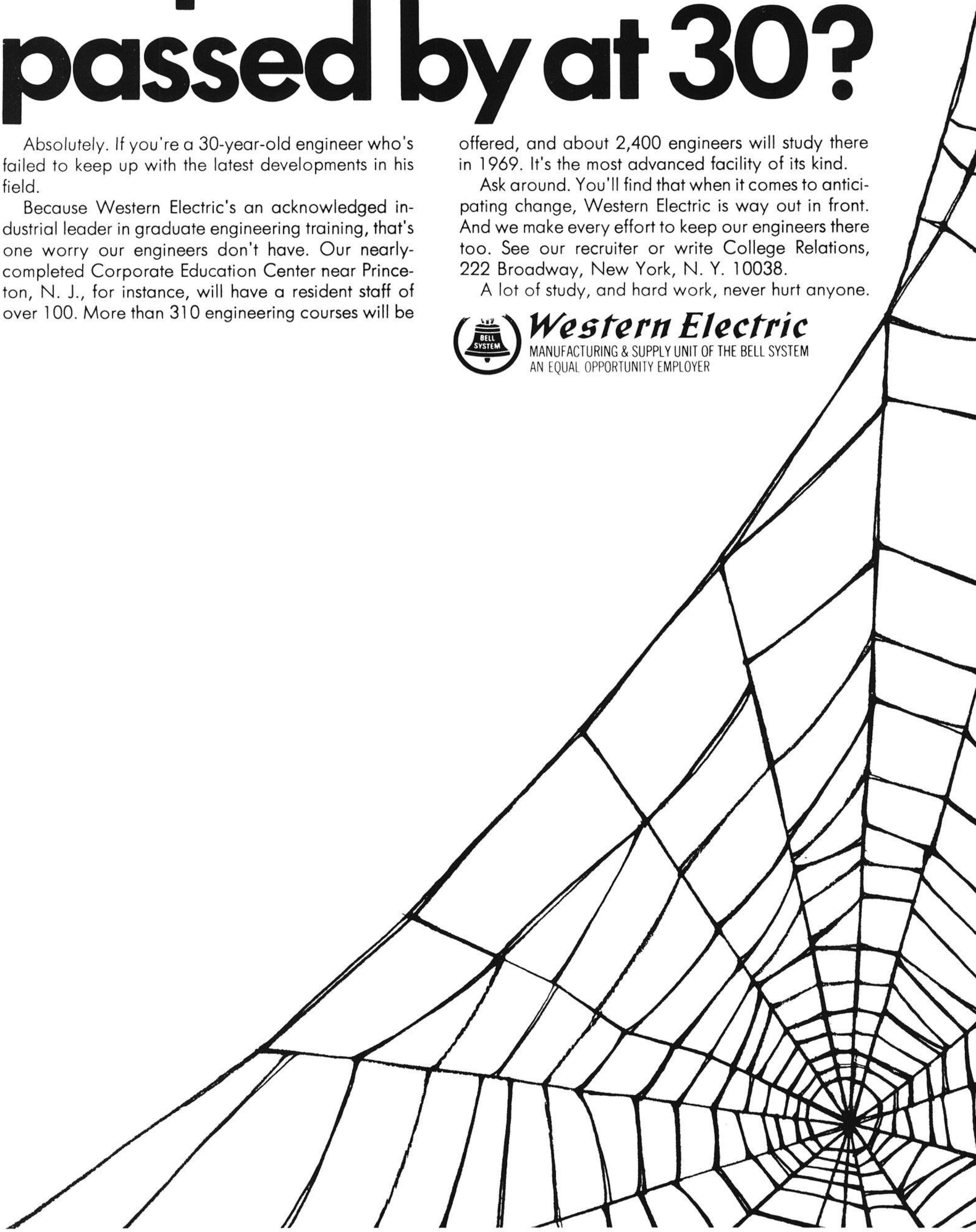
Ever since I can remember, and probably many years before that, there has been a separation of the engineering campus from the rest of the university. The situation was climaxed last year during the Dow Chemical incident. Since then a tense atmosphere has prevailed between the engineers and the hill students. This can be attributed to a basic difference in the interests of the individuals in each sector and a difference in type of education each receives. Speaking as an engineering student acquainted with both sides, I think this difference is and probably always will be present, although there is no need for hostile attitudes to be built up on either side.

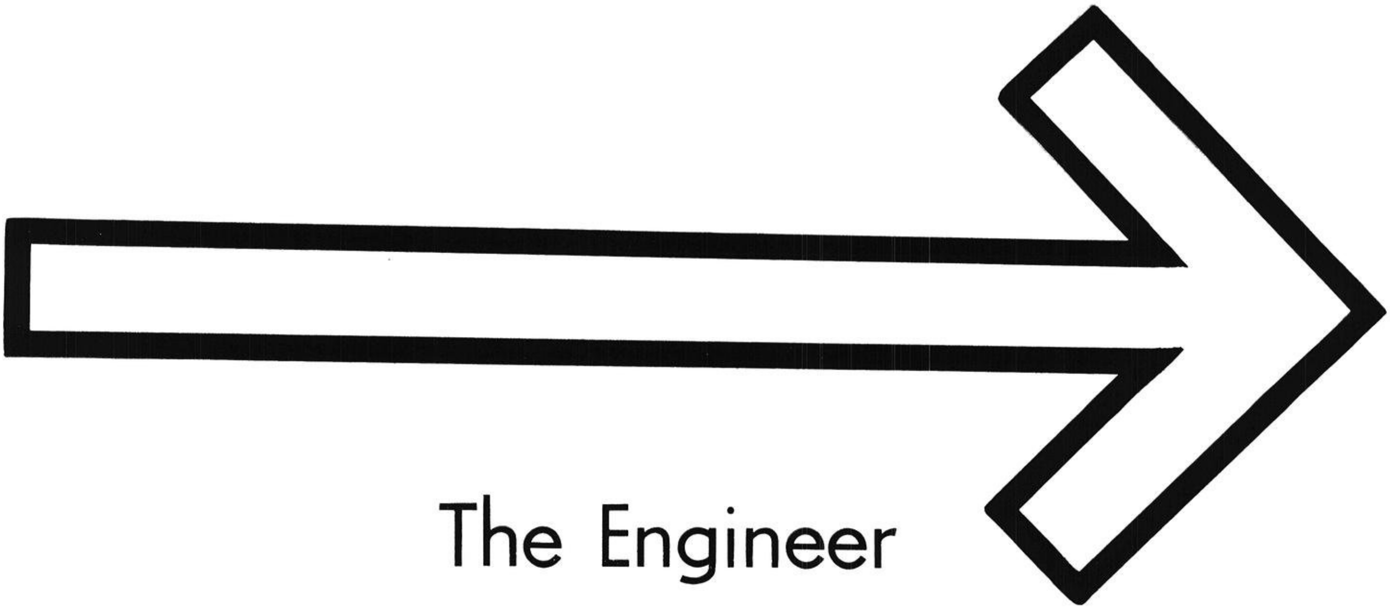
The first and truly vital difference between the engineer and the liberal arts student is a difference of interest. Whatever the engineer's reason for choosing his field, whether it be design, research, production, or whatever, it is his personal choice. The liberal arts student also has his aims and goals and, although they are different from the engineer's, they are just as valid. In general, this student is more interested in the arts, abstract thinking, and the present society. He is probably more politically active because his interest covers a broader range. He is more conscious of his role in society and functions accordingly. He is less likely to be materialistic and strives more for individual satisfaction, idealism, and self improvement.

The difference in educational systems serves to widen the gap between the two schools. As engineering students become more educated, they begin to converge and specialize in their field. This tends to narrow the outlook of the whole person, and we have an initial hostile attitude being magnified. A broader education would help eliminate this problem.

The liberal arts student's education, as compared to the engineer's, is more subjective. A noted English professor has said that a liberal education cannot be attained, but must be experienced by the individual. While a person can be lectured to objectively, it is through experience, and not mental feedback, that a person is truly educated. It is through experience that education becomes a part of one's personality. The intellectual stimulation of the arts through liberal studies versus the vocational training of engineering tends to widen the gap between the two.

There are no true generalities that can be made about the two schools, but there are characteristics which each faction seems to have. The liberal arts student tends to be broader, more liberal, and to have a less prejudiced outlook on life. We all play this game of life, but it seems the liberal arts student has a slight advantage. Could we be doing something wrong?





The Engineer

(with apologies to Carl Sandburg)

by Peter W. Egan

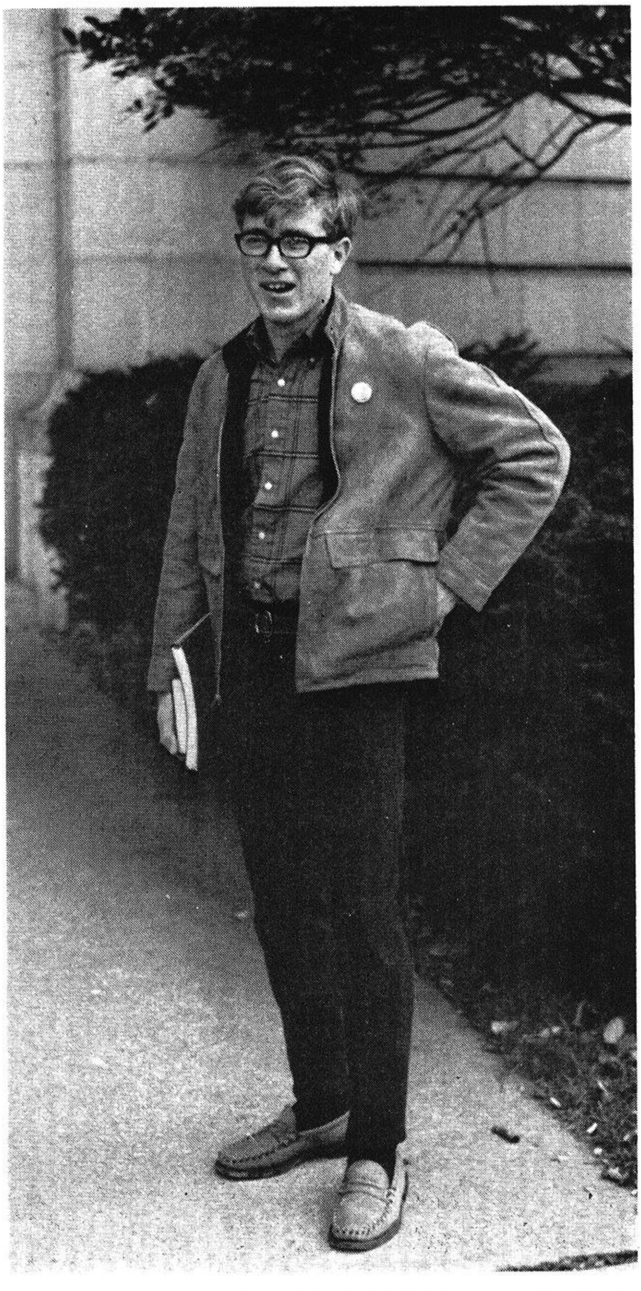
Bomb Builder for the World
Card Puncher, Counter of Ergs
Player with Atoms and the Nation's Scapegoat
Trivial, Vital, Placid
Students of the Big Trade School
They tell me you are wicked and I believe them, for I have seen you kill sheep from forty miles away with the latest nerve gas
And they tell me you are tasteless, and I answer: Yes, it is true for who else would wear a plaid sport coat with a paisley shirt to a Bobby Vinton concert
And they tell me you are boring and my reply is: On the faces of your dates I have seen the marks of creeping horror as you begin to itemize the components in your latest Heathkit
And having answered so I turn once more to those who sneer at these my fellow students and I give them back the sneer and say to them:
Come and show me another minority group with lifted head snickering so proud to be assured of a solid twelve grand and a box in the suburbs*
Flinging quite printable curses amid the toil of studying night upon night, bursting with determination or devoid of imagination
Counting
Calculating
Slide Ruling
Balancing
Coming, Multiplying, Conquering
Under the credit load, chalk all over his hands, laughing with Dow-Jones
Under the terrible burden of quantum mechanics, laughing when he can
Laughing even as an hysterical NASA man laughs who has just pushed the wrong button
Bragging and laughing that under his skull is the know-how, and under his ribs the cavity of fate

Laughing?

*and you can take that any way you want it**
**or get it

Bilateral Love

by Dave Stroik



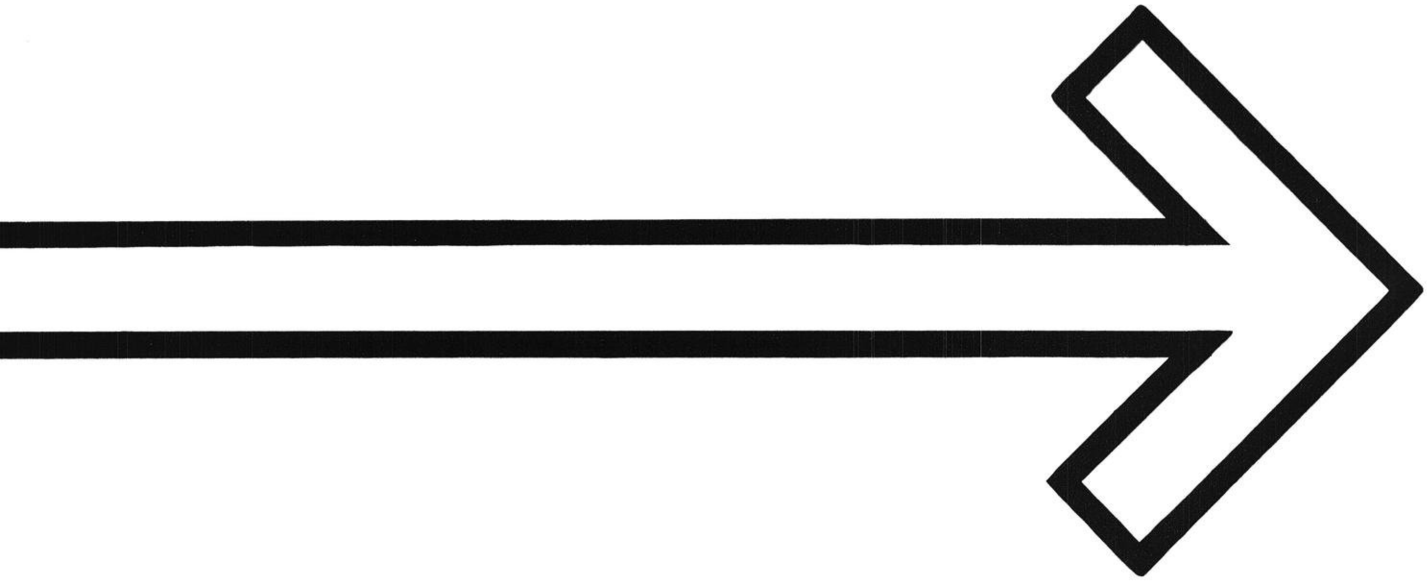
Perhaps it's a failure to communicate, or just a lack of understanding, that's creating the barrier between the hill students (liberal arts students) and the valley students (engineers). The presence of such a rift was graphically demonstrated to me when I witnessed the accidental meeting of Betty Buststein and Harvey Halstead.

With each long stride the slide rule in Harvey's back pocket swayed from side to side. He'd regularly run his fingers through his short unruly hair to counter each gust of wind.

"Help me," came a soft yet distinctly New York voice from behind a clump of bushes.

Harvey glanced at his watch and decided he could spare a few minutes to check out this maiden in distress. As he rounded the bushes two large brown eyes peered up at him. Sweeping her hand across her forehead she removed a lock of long raven hair from her line of sight. "I'm stuck," she said tugging at her bellbottoms.

Harvey's eyes moved down her leg to the piece



of deep blue cloth pinched in the bicycle chain. He bent down and began pulling the chain and wiggling the pedal while an assortment of beads and peace medallions banged against his head. "It'd be a lot easier if you weren't in 'em."

"I could take them off, but I'm not wearing any underwear," she said pulling the bellbottoms down slightly to expose a bare stomach. "See."

Harvey let out a quiet high pitched squeak. His hands grew moist and shaky. "Ya, I can understand; there's been a lot of pantie raids lately," he quivered.

"But if you think it would help . . ."

"No!" he screamed grabbing her hand as she reached for the zipper. "I'll manage." With a sigh of relief, Harvey took off his shoe and used it to pry at the stubborn chain. Suddenly the bellbottom fell limp.

"Oh, you're so mechanical," she cried and locked her arms around his.

Balancing the bike with one hand, and holding his shoe with the other, Harvey finally managed to break her grip. "We don't even know each other."

"I'm Betty Buststein."

Harvey extended his hand. "I'm Harvey Hal . . ."

"Oh, Harvey," she squealed throwing her arms around his neck.

"Now cut that out!" yelled Harvey turning his head from her extended lips.

Betty moved back and fingered a peace medal. "You engineers are all such archaic realists. Don't you believe in love?" She tilted her head and looked into his eyes. "See that tree?" she said motioning to a stately maple.

"Ya."

"It lives and loves living. Inside that tiny hole a tender little heart pumps the vital sap," Harvey stood on his tip toes in an effort to see the heart through a woodpecker hole in the side of the tree. "And the shiny leaves express how happy it is to live and love."

"What you need is a good chain guard."

"Pardon?"

"A thing to keep your pants away from your chain," said Harvey pointing to the bicycle.

"Damn the chain guard or whatever — I want you." She pressed herself against him.

"Now you did it!" said Harvey reaching for his back pocket. "Busted my slide rule."

"Oh, I'm sorry," she said. "Maybe you can glue it."

"It's a Werner von Braun autographed Picket number 786 bamboo slide rule with forty-seven log — log scales — you don't just glue it!"

Betty threw up her hands and looked at the sky. "Oh the bureaucracy and institutionalism of it all!"

"Huh?"

"Don't you see? Some Guru in a black suit says do your thing, have a nice house in Suburbia, and get old." Harvey felt his day old beard. "So you chain yourself to your slide rule, bust your body and never see the sky."

"Oh ya," said Harvey pulling his finger from his nose. "Well, I've got a test in five minutes."

"See — you poor thing, all caught up in your papier mâché world." She began stroking his chest. "Revolt. Build a new existence with me."

Sweat poured down Harvey's face. "I'm going to be late," he squeaked. "And, besides, my mother told me about girls like . . ." Betty pressed her lips to his. "like you," he mumbled from the corner of his mouth.

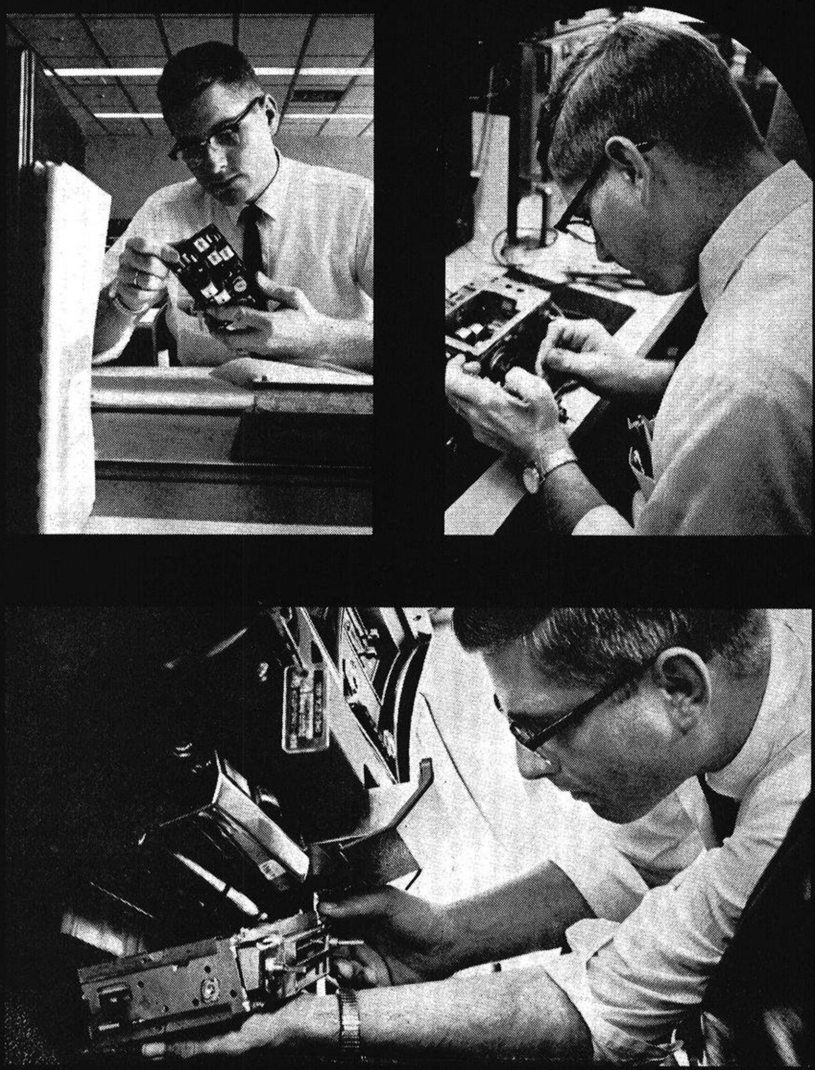
"Sleep with me."

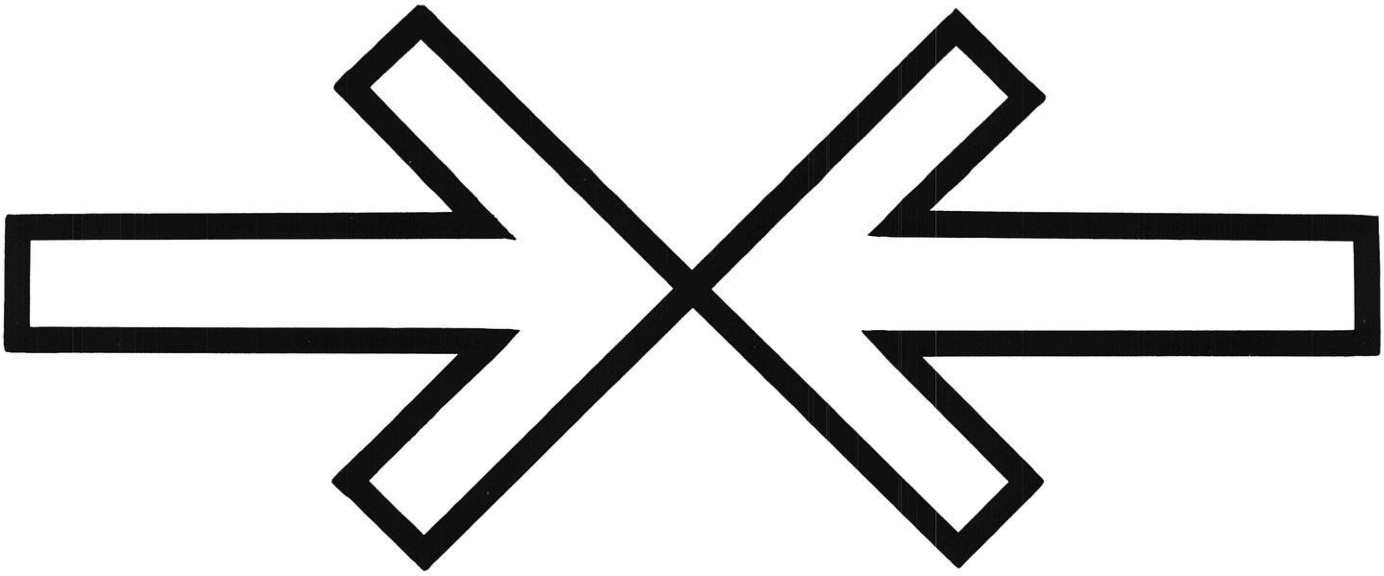
"Not on your life, you . . . you hussy," he said mustering as much morality as possible into his trembling voice. "I got my Nuclear Magnetic Resonance 351 test to take." He forced her arms away and turned to walk off. "Uh."

"Yes, Harvey."

"Where's Bascom Hall?"

Thus I observed the two vastly different subcultures developing on campus. Neither extreme seems entirely ideal. I see but one solution to the problem — intermarriage. Perhaps the offspring of such a coalition would be at least semi-stable.





The Hill Student Is . . .

by Dick Wagner

A hill student is a person without a sliderule, who has an incomplete sense of humor and who is concerned with the little variables that affect his environment (i.e., he wants to gain a solution to his problems by concentrating with impartial emphasis on the variables and tinkering with the constants — yea, truly fudging!).

A hill student is guided by human nature (each a demagogue at heart). He is especially interested in playing the part of a human being. Finding social, ethical, and even physical barriers sometimes in his way, the hill student may display his envariably efferent characteristics.

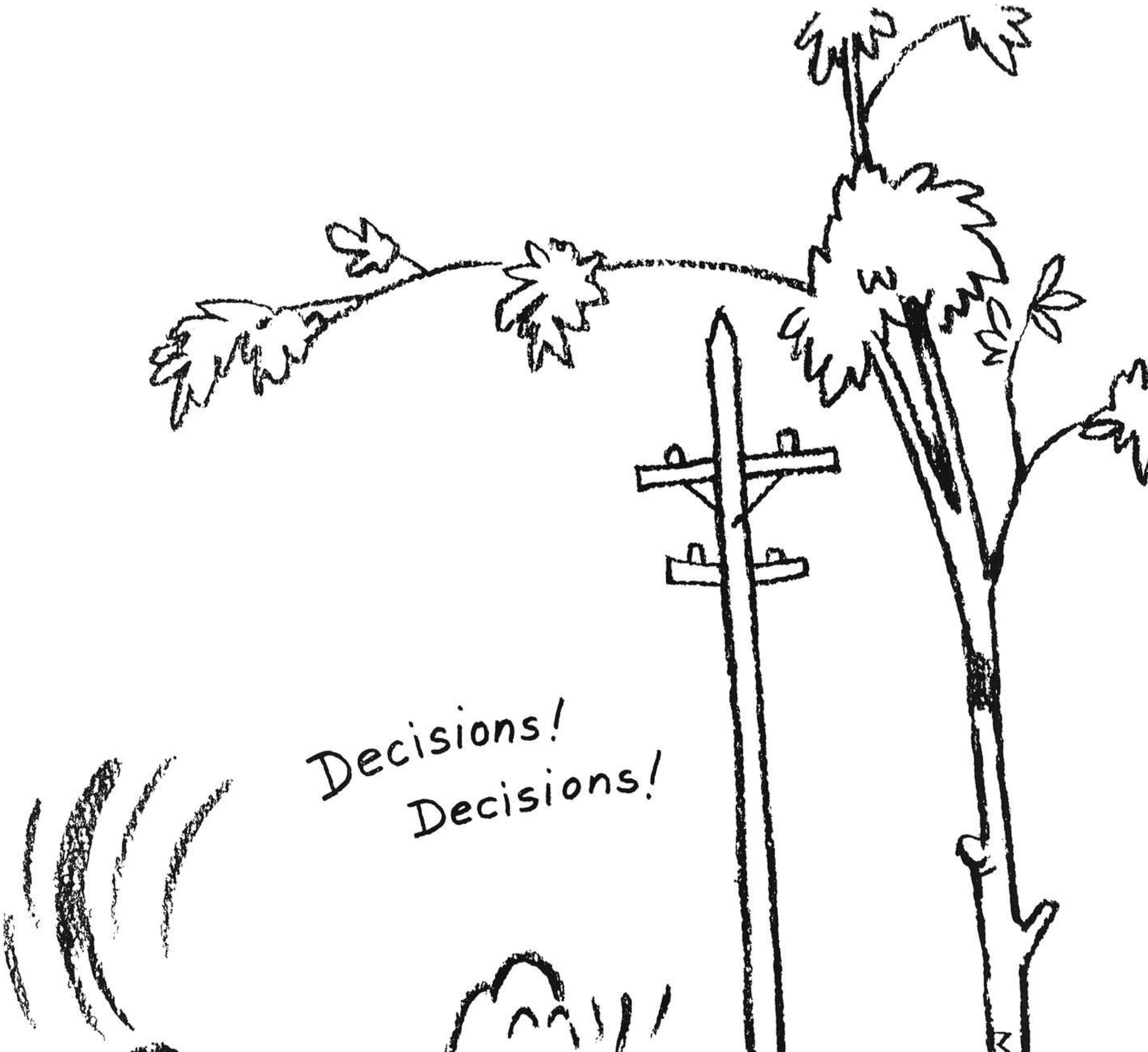
A hill student, although not necessarily always outspoken by nature, easily becomes this way if the opportunity arises.

To a hill student, "status quo" is the ultimate modus vivendi; the present is another subject!

To him all information is either known or within intuitive grasp. Nothing, however, is taken lightly or assumed without laborious consideration.

A hill student's sense of humor is limited by his sense of involvement; but enhanced by his subjective tendencies; enhanced by his expressive abilities; enhanced by his moods. That is, he has a very good sense of humor, although involvement may cancel objectivity (hence an incomplete sense of humor). Herein lies *no* tragedy, probably because pure humor is not completely good.

A hill student is a concerned, care free, independent member of a dependent society. He is full of energy. He wears what he likes. He answers first to an impulsive conscience. To a hill student, time is of the essence, although it seems to be his greatest commodity.


Decisions!
Decisions!

The Technical Side of Automobile Accidents

by Frederick J. Furer

One of the evils of our age which is receiving increasing publicity is the automobile accident. There are many different aspects of automobile accidents which may be studied, such as the psycho-physical condition of the drivers, the design of the vehicles involved, the layout of the highways and intersections where accidents occur, and many more. This article deals exclusively with the comparatively narrow subject known as engineering analysis of accidents.

In accidents of any consequence, a judgment must be made to determine who was at fault. This judgment is ordinarily based on the rules of the road, so that a person driving in the wrong lane would be at fault in an accident even though he may contend that he was blinded by bright sunlight. Thus, the liability for an accident is based on the physical motions of the vehicles and not directly on the drivers. It is this fact that puts analysis of accidents, for the practical purpose of determining liability, in the realm of engineering.

In the vast majority of accidents, no analysis is needed because one party or the other concedes liability, or else the damage costs are too small to warrant an analysis. In the remaining number, engineering analysis can be of utmost importance in establishing facts.

First we must be clear as to what we mean by "accident analysis." Accident analysis is the determination of pertinent facts, using the available physical evidence, with due consideration given to the testimony of witnesses. An engineer who does accident analysis would not be called an accident investigator, for an accident investigator merely gathers facts while an engineer evaluates the facts. But sometimes the engineer must gather his own data since he alone may know what to look for. The engineer does not take sides in the case, but only presents the facts as they are. The evidence is generally favorable to one side of the case, and it is ordinarily that side which sponsors the analysis. The engineer who presents his analysis in a court of law is commonly called an "expert," and this will be the meaning of the term as it is used in this article.

The purpose of this article is to acquaint the engineer with the general procedures of analyzing accidents. The engineering principles involved are only a small part of the solution to the problem—the rest being mostly experience, with a little luck thrown in. It should also be pointed out in passing that while many cases, after being analyzed by an engineer, are settled out of court, many others go to court, and in court the testimony of an experienced expert carries much more weight than the testimony of an inexperienced "expert." Therefore, an engineer not directly involved with the motor vehicle field is not likely to be asked to do an accident analysis.

THE NEED FOR ACCIDENT ANALYSIS

It has already been indicated that an engineering analysis is needed whenever the liability for an accident has not been completely determined. To expand upon this further, the situations where an analysis is needed can be broken down into three divisions. These divisions are not distinct, as will be seen, but they do aid in clarifying what the engineer who does an analysis is up against.

Obvious Conclusions

Many automobile accident cases whose physical events are known and accepted by both sides are brought before the courts for judgment on how much the settlement should be. The expert is needed in cases like this because the plaintiff will want to present as strong a case as possible and this is best done with an expert's testimony.

Obvious Conclusions That Are False

Sometimes an accident will occur that seems to be the fault of one driver, and the police investigating the accident, may sum it up by saying that he was, in fact, at fault. This puts the driver (and especially his insurance company) in a bad situation, since automobile accidents often result in large settlements to the other party. If the accused driver is not really at fault, an engineering analysis can throw new light on the evidence and disprove the original conclusion.

Cases like this can be the toughest of all because the engineer must convince the judge and the jury that what seems to be the situation really is not. Furthermore, this must be done using technical considerations in nontechnical terms. What would be easy to show to another engineer can be almost impossible to explain to people who have no engineering training. To make things worse, not everyone in the courtroom wants the engineer's analysis to be understood and accepted. During

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cross-examination, the lawyer might ask, "Can you state positively that the coefficient of friction is *exactly* 0.65 for the road in question on July 24, 1962, at 3:47 a.m.?" Of course the answer must be, "No." And then he might ask, "Isn't it also true that the coefficient of friction might be anywhere from 0.61 to 0.69?" Even if the answer to this is "Yes," and it probably would be, this amount of variance in the coefficient may have no serious effect on the final results. The reason the cross-examining lawyer asks questions such as these is to emphasize to the jury that the analysis is not *exact*. Thus, the jury may become biased against the analysis unless the analysis is clearly and completely presented in direct examination. It is important for the engineer to be aware of the difficulties if he must testify in court.

A hypothetical example will serve to illustrate what is meant by an "obvious conclusion that is false." Suppose two vehicles are approaching an intersection as shown below in Figure 1. Neither car stops, and they collide near the center of the intersection. After the crash they come to rest as shown in Figure 2.

The police report would probably state that the driver of vehicle A is at fault because before the crash, vehicle B was approaching from his right, giving that driver the right-of-way. Also, the final position of the vehicles indicates that vehicle A was traveling at a high rate of speed since it carried vehicle B a long way from its original path.

The driver of vehicle A would have a hard time convincing anyone that he was traveling at the legal speed limit and, that when he reached the intersection, there was no car in sight. But an engineer could substantiate the driver's claim. Suppose there are tire marks on the pavement which show that vehicle B was cornering hard to its right just prior to the impact, probably in an

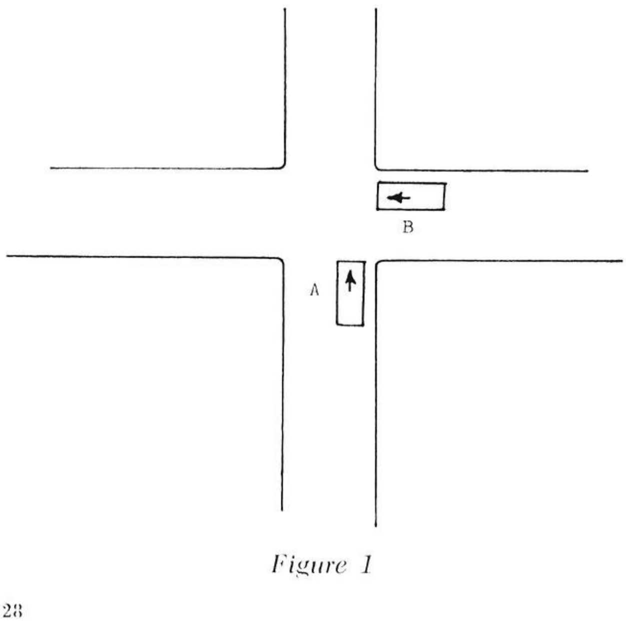

Figure 1

attempt to avoid collision. Suppose also that the damage to the vehicles supports the tire mark evidence in proving that, at the time of collision, vehicle B was at an angle of 45 degrees with respect to vehicle A. With this evidence the engineer can show that, not only was vehicle A not speeding, but that vehicle B was speeding, and, therefore, its driver loses all claim to the right-of-way.

No Obvious Conclusion

Often there are no witnesses to an accident or the witnesses have conflicting versions. Here, the engineer must reconstruct the accident and then present his unbiased interpretation of the facts. Generally, the engineer does his analysis for one of the insurance companies involved, or their lawyers. Their decision to use the analysis or not depends on how favorable it is to their position.

The three things that must be determined in an analysis of this type are: the speeds of the vehicles before the accident, the orientation of the vehicles at the instant of impact, and the manner in which the vehicles got into this orientation. It should be pointed out that most analyses of this type are, at best, opinions. There are so many variables that can not be precisely determined that an exact solution is impossible. Sometimes the only way to get solutions is to assume initial conditions and either show that these could or could not have produced the apparent results. This trial and error method is used until a particular set of assumptions fits the data.

THE BASIC LAWS AND FORMULAS

Two fundamental concepts of nature are used in analyzing accidents: ENERGY and MOMENTUM. Each will be briefly explained, and the important formulas that may be derived from them will be shown.

Energy

There are four kinds of energy that apply to accidents. They are:

1. Kinetic energy, or energy of motion
   $KE = (mv^2/g_c)$ where m is mass; v is velocity
2. Potential energy or energy of elevation
   $PE = (g/g_c)mh$ where h is the height above an arbitrary zero datum; g is local gravity
3. Heat or energy transferred due to friction
   $HEAT = \mu Nd$ where μ is the coefficient of friction; N is the normal force; d is the distance through which it acts
4. Energy of collision (estimate based on extent of damage)

It is a fundamental law of nature that energy can be neither created nor destroyed, and it is this principle which makes the consideration of energy useful.

Velocities in automobile accidents are mostly conveniently considered in terms of miles-per-hour, but controversial energy equations usually require that feet-per-second be used. With the proper conversion factors, the kinetic energy equation can be written in a more useful form, where the velocity is in miles-per-hour as:

$KE = WV^2/30$ where W is the weight of the vehicle; V is velocity; g is assumed to equal g_c numerically since $W = (g/g_c)m$

Consider a vehicle of weight W coming to a stop from speed V, with all wheels locked. The frictional force is then μW. If the skid distance is S, we can relate the frictional heat liberated to the initial kinetic energy as follows:

$$KE = WV^2/30$$

$$HEAT = \mu WS$$

$$KE = HEAT$$

$$\frac{WV^2}{30} = \mu WS$$

$$V^2 = 30\mu S$$

This is a very important equation. It is used to find μ when V and S are known, and V when μ and S are known. The derivation suggests the general form for finding initial speed of a vehicle when the vehicle converts energy several different ways before stopping. For clarification, a specific example will serve. Suppose a vehicle slides x feet on the pavement, y feet on the shoulder, and z feet in the grass. At the same time, its center of gravity moves up a total elevation of H feet. Its initial kinetic energy will be equal to:

$$KE_{initial} = WV^2/30 = W\mu_p x + W\mu_s y + W\mu_g z + WH$$

From this equation, the initial velocity can be calculated. If the vehicle had done damage to itself or any other object, the amount of energy required to do the damage would have to be estimated and added to the right side of the equation.

Momentum

Momentum is the other main consideration for analyzing accidents. Momentum is the product of mass times velocity and has direction as well as magnitude. Thus, a 4,000-pound vehicle traveling north at 10 miles per hour would have a momentum of 40,000 pound-miles/hour, where north is considered the positive direction. The same vehicle traveling south at the same speed would have momentum of –40,000 pound-miles/hour. Usually, momentum is given in pound-feet/second, but any consistent units are valid, and pound-miles/hour happens to be convenient.

The change in momentum is equal to the product of the force acting in the direction of the change times the time during which the force acts. This product is called impulse. In the analysis of accidents, time is never a known quantity, and it rarely needs to be calculated. So, the technique used is to define a system in which the impulse on the system can be taken as zero and, therefore, momentum does not change. This is the basis of the conservation-of-momentum concept.

The hypothetical example given previously concerning the collision at the intersection would be analyzed by the principle of conservation-of-momentum. In this example, the initial velocities are not known, but the directions are. The mass of each vehicle will be assumed to be the same. The final velocity after impact is also not known, but it could possibly be calculated from skid marks and the coefficient of friction. But the final velocity need not be known. The ratio of x-momentum and y-momentum before the collision must equal the final ratio of momentum after the collision to have momentum conserved. This ratio is also equal to the ratio of the x and y displacements after the collision and, therefore, the situation may be analyzed as follows:

$$\frac{\text{Init. Mom. in x-dir.}}{\text{Init. Mom. in y-dir.}} = \frac{\text{Final Mom. in x-dir.}}{\text{Final Mom. in y-dir.}}$$

$$= \frac{30}{50}$$

$$\frac{mV_b(\sin 45^\circ)}{mV_a + mV_b(\sin 45^\circ)} = \frac{30}{50} \qquad \sin 45^\circ = 0.707$$

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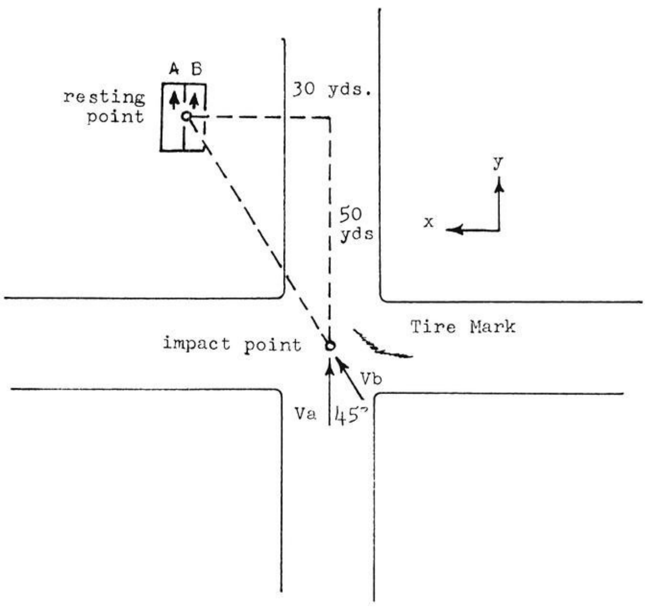
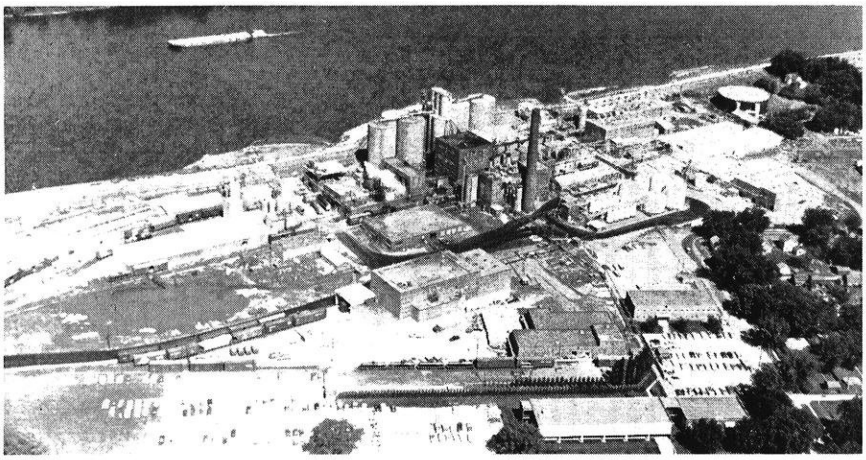
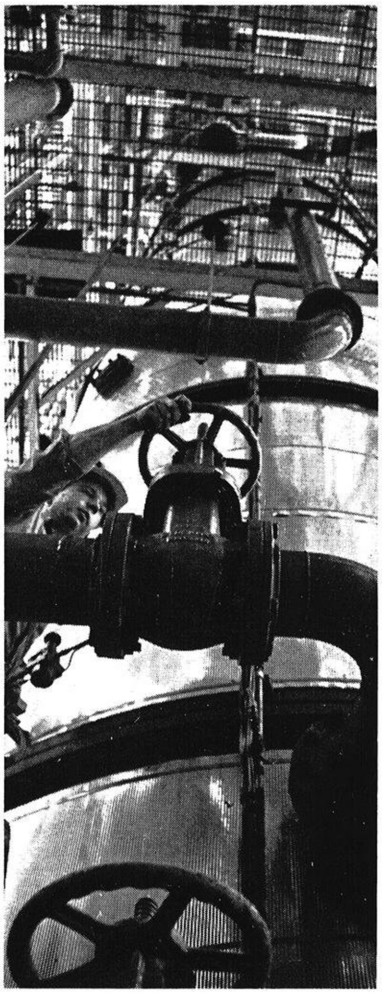
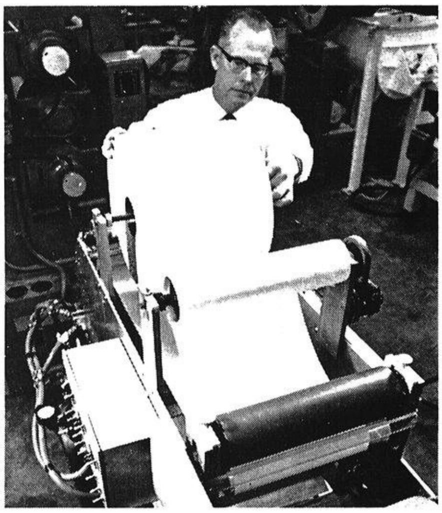
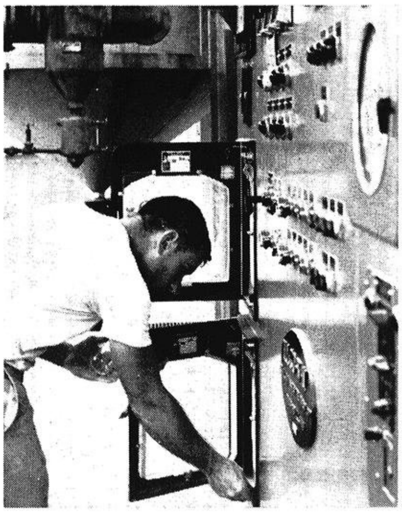


Figure 2









Computerized Traffic Controls

by James R. Miller

As vehicular traffic increases both in density and complexity, effective control systems to minimize delays become more and more essential. With the advent of the computer in traffic control, this problem of minimizing delays has come much nearer to being solved. This report deals with what actual function the computer has in controlling traffic.

Today's complex traffic systems demand the efficiency and the high-speed capability that the computer offers. With the help of the computer, the traffic engineer can control an entire city's traffic system with great efficiency. Through a system of sensors around each intersection, the computer knows the exact count of traffic using each intersection. When the traffic flow changes at a particular intersection, the computer changes the cycle time of the traffic lights at that particular intersection.

A computerized traffic system is now in use in many cities throughout the world. Toronto, Canada; San Jose, California; and Wichita Falls, Texas, are among these cities. Traffic engineers say that the computerized traffic system will come into general use in the future in any city with a population of 100,000 and over.

The capability of the high capacity computer does not end with intersection control. With the aid of lasers and many other electronic devices, the computer in the future will control much more of the traffic system.

The Reason the Computer is Being Used

The traffic stream appears to be analogous to many familiar flow problems, such as those in paper mills, refineries, and water supply. Just as the automatic control of these processes requires sensing devices to measure flow rate, temperature, fluid density, and other properties, so must the traffic stream have its sensing devices and coordinating system if automatic control is to be achieved.

The complexity of modern transportation networks and the diverse classes of vehicles traveling on the facilities also require that the most sophisticated measurement, analysis, surveillance, and control methods be employed. Several such techniques now within the electrical and electronics disciplines, are being taxed anew by traffic demands. The most promising of these new techniques is the use of the computer in traffic control.

The Setting Up of a Computerized System

Since no city can afford, nor even need, computer control for every intersection, the problem of finding out which intersections to put under computer control has to be solved.

The preliminary step in solving this problem is getting a traffic count of all in-bound and out-bound lanes at all intersections that are being considered for computer control. This is done by simple portable pressure sensors which count each car as it passes a certain point on the road.

Once the volume of traffic at each intersection is determined, the traffic engineer and computer manufacturer take this data and determine which intersections they will put under computer control. This determination is arrived at by assessing what the computer is to accomplish and what type of system is to be used.

Once the intersections are chosen, the computer must be programmed to handle different traffic situations which might arise throughout the course of a day. This involves having traffic researchers from both city and computer manufacturer attack the problem in one of three ways: by making real-time observations and gathering system-wide data on the effects of existing intersection control techniques; by imposing computer generated strategies of increasing sophistication; or by letting the intersections revert completely to local control and accumulate data obtained by such a method.

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Once the data is obtained from the above methods, the actual laying out of traffic patterns takes place. That is instead of having just one sequence of lights for all day, a number of different light patterns will be used. It is the computer's job to pick which sequence will best fit the traffic situation, at each particular intersection during the course of each day.

In order that the computer can judge what sequence of lights best fits the situation, sensing devices are placed in or about the road to obtain data on the traffic situation and relay it to the computer.

Sensing Devices in the Computerized System

Traffic engineering journals are replete with advertising and technical articles on sensing devices of many different types. Much of the equipment used in traffic sensing since orld War II has gone through an evolution from relatively simple electro-mechanical devices, to electronic tube and relay devices, to the present solid state devices now being offered.

For almost 20 years engineers relied on two basic types: the magnetic detector and the pressure-sensitive detector. Since the magnetic detector was not efficient enough, and the pressure-sensitive type could not be used in the north where the streets were plowed, the inductive loop type was developed and is most widely used now. There also have been reports on experimental work in which lasers are used to detect, classify, and measure vehicle speeds.

How the Computer Uses the Data Obtained

Through the array of sensing devices, the computer obtains data on the traffic flow for each instant of time. The computer uses this data to make six measurements:

1. Volume per lane

The number of cars passing over detectors for each approach lane to each signal is noted at five-minute intervals.

2. Average speed

This is calculated as a five-minute average using an average vehicle length of 17.1 feet. The speed figure has a high inverse correlation to congestion.

3. Stops per lane per cycle

The computer does not actually count stops, since it has no way of detecting them. Knowing, however, the distance from the loop to the stopline, the average speed, and the condition of the traffic light, it can register as "stopped" any car that has passed the approach loop without enough time to catch the green light. Those which speed up on the yellow signal it considers statistically insignificant. If a line stretches past the detector loop, of course, the computer cannot count the last cars.

4. Demand per lane per cycle

This is the number of vehicles per green-yellow-red cycle which approach a signal in each lane.

5. Delay per vehicle

This figure, the most important in evaluating the system, is calculated from the number of stops and is measured in vehicle-seconds.

6. Lane occupancy

This figure is obtained as a five-minute average.

The measurements—some 500,000 a day — are the basis for making changes in the only three variables in a traffic light system: cycle, split, and offset. Cycle is the length of a green-yellow-red sequence, split is the ration of red time to green time in any given cycle, and offset is the difference in time between green lights at neighboring intersections.

These variables may be manipulated in any number of different patterns, all of which are very involved and will not be discussed in this article.

Different Levels of Traffic Control

The computerized system represents the apex of an increasingly complex hierarchy of traffic control systems. At the bottom rung of this hierarchy is the so-called uncoordinated system, characterized by a lack of tie-in among intersections. In the simplest uncoordinated system, the signal head is cycled from green to yellow to red by a constantly rotating dial in the controller to produce an unvarying split (green-light proportion of each cycle), chosen on the basis of the average traffic loading at the intersection in question.

The next step up in complexity in uncoordinated equipment is the semiactuated controller system, in which a pressure sensitive treadle, magnetic loop, or other vehicle detection device is placed on both sides of a road a few yards in front of an intersection. In this case, as in the fully actuated case in which detectors are set into both intersecting roads, there is no fixed cycle length and the split is adjusted on the basis of instantaneous traffic in the two cross streets as determined by the detectors. (Note that a treadle can only count vehicles, a loop can determine presence as well, a CW doppler radar does both plus measure velocity, and an ultrasonic sensor can add vehicle identification.)

In coordinated systems, the signal heads of successive intersections are linked in some orderly fashion, usually resulting in a "green wave" traveling from light to light. The delay in signal change between successive intersections is called the offset.

As mentioned before, cycle, split, and offset are the three basic variables that a traffic system manipulates to optimize signal light control. Such manipulation can be effected manually, by analog control, or by digital computer, depending on the complexity of the system and on the optimization desired.

In the simplest coordinated scheme, all three variables remain constant, there being no on-line manipulation. However, a single constant offset is now generally regarded as highly inadequate to cope with the changing traffic patterns that occur during a day. Thus, many cities have replaced the single-dial controller with double- and triple-dial types to give two or three offset choices instead of one.

Next in our traffic control hierarchy comes coordinated actuated systems. In this scheme, a series of successive intersections are controlled from a central analog computer linked to a cycle generator. Cycle lengths are selected on the basis of traffic data received from detectors flanking the strip of intersections involved. A typical system of this type might offer six different cycle lengths, five offsets, and three splits.

Examples of Places Which Have Installed Computerized Systems

The first major city to use computer control in a big way was Toronto, Canada, with a population of almost 670,000. Toronto now has a $5 million investment in its system. On its investment, the city has had a substantial return. Its traffic commissioner estimates that trip times have been reduced by as much as 20% and that the number of involuntary stops has been slashed by more than half. Toronto now has some 500 traffic lights — covering the major arteries — under computer control.

San Jose, California, with a population of about 330,000, has the biggest computerized traffic control system now operating in the United States. For the past two years, San Jose has been cooperating on a program in which an IBM 1710 collects data and controls traffic light strategies for 59 intersections along one main artery and in a downtown grid.

IBM also has an 1800 computer installed for traffic control in Wichita Falls, Texas. With a population of 101,000, Wichita Falls proved that the smaller cities also profit from a computerized system.

Because of these results through the use of computers in these cities, traffic engineers are saying that any city over 100,000 population should have some type of computerized system tied into the traffic signals.

Future Applications

The immediate future of the transportation field is vastly more promising than that of the past. Many agencies, public and private, are involving themselves in the development of new concepts, new devices, and new applications.

Remote "eyeballing" of specific problem areas is possible through strategic placement of video cameras. Surveillance of traffic flows by closed-circuit television or other types of detecting devices permits optimum utilization of crowded streets.

From these TV records, traffic officers can spot accidents, congestions, pile-ups, and they can dispatch squad cars to trouble spots. Traffic control officers can break into the automated system and take remedial action in case of equipment trouble. There can also be mobile cameras for specific use in case of special events.

The U.S. Bureau of Public Roads BPR) has recently commissioned the Philco Corporation to prepare a report on a "language" that could be a coding technique for route recognition and position description. Such a language would be invaluable in the control of a traffic system embracing the East Coast megalopolis, for example.

The technique of driving involves a continuing series of adaptive reactions to changing road conditions, changing vehicle responses, and changing driver attitudes. Most of the adaptations are simple decisions. However, even simple decisions, easily made, become complex when they are coupled with five or six other such decisions, all of which must be made within seconds.

It is to eliminate the necessity for making these decisions, or to space them over more reasonable time periods that much of the efforts of engineers concerned with traffic have been directed. Larger or better-located signs, limited-access roadways, and more efficient signal systems are the older tools employed. Variable-message signs, automatic vehicle control, automated highways, and computer-controlled signal systems are a few of the exciting new tools.

Direct driver advisories, utilizing radio and pre-recorded messages, keyed by roadside transmitters, are perhaps needed. Providing real-time response, computers could be capable of assimilating vast amounts of data and quickly providing the information necessary to the driver.

The Ever Progressive Industrial Engineers

by Dick Wagner

This is an attempt to digest all of the information available about research being conducted by the Industrial Engineering Department at the University of Wisconsin. The main areas of research are "WRMP"; Human Factors Engineering; Water Quality Management; and Programming for Employment. We greatly appreciate the writings submitted by the I. E. department.

This is the first in a series of articles which will probe the research projects under way in the various engineering departments here in Madison.

WRMP

Goal of the WRMP: Improve health status of citizens of the region.

•

"Systems or industrial engineering, frequently used in designing large scale complex systems, has been employed in the planning process of the Wisconsin Regional Medical Program, Inc. (WRMP). This profession has at least three strengths that render it useful for such activities: (1) a systems design strategy, a 'framework for thinking' that structures the planning process in a more effective fashion, (2) an interdisciplinary framework that brings together various professionals to work jointly in such settings, and (3) tools and techniques that can be used in allocating resources required in the master plan.

"At its inception, the WRMP decided to use systems engineering as a major component of its planning process. Through a contract with the Engineering Experiment Station of the University of Wisconsin, staff support was obtained to provide industrial engineering and operations research services. In order to obtain the continuity needed to make these services productive, an industrial engineer was appointed chairman of the planning committee.

"Essentially there are three levels at which planning proceeds in the WRMP: conceptual, strategic, and operational. Conception planning develops the goals and objectives of the WRMP and provides the mechanism for improving them through a continual assessment of the WRMP's strengths and weaknesses. Strategic planning is the level at which the WRMP determines what it should be doing now and in the future to achieve the objectives established at the conceptual planning level. Operational planning develops the means of implementing the specific programs conceived at the strategic level."

This has been part of a report submitted by the planning staff of WRMP (David H. Gustafson, Ph.D.; Paul C. Nutt; and Gerald Nadser, Ph.D.), that predict "**planning** an essential WRMP component for years to come." The staff began its work in 1966 and now has over four grad students involved in its workings.

HUMAN FACTORS ENGINEERING RESEARCH

Prof. Gordon Robinson is conducting research in the area of automobiles and the human driver under a Public Health Service grant. The function of this research is to show the human's role as a component in a control system. This system depicts the man-machine relationship as found in the driver and the automobile.

Some of the aspects of the research at this time include the measurement of eye movements and head movements as related to the various activities of a driver such as turning and braking. These measurements will be taken on the road first, and, later, similar conditions will be simulated in the lab.

Another area being studied is that of depth perception as related to fatigue, alcoholism, and other factors.

The purpose of these studies is to determine how the human driver will react to the different inputs to the auto-driver control system and what methods can be used to train the driver to react favorably to these inputs.

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WATER QUALITY MANAGEMENT

This research is part of an interdisciplinary research project at the Water Resources Center to determine the effective design of political institutions and laws for managing water quality in a river basin. The Wisconsin River Basin is being used as a case study.

Recalling that the primary functions of management may be described briefly as: setting objectives, planning the actions necessary to gain the objectives, and then controlling the actions and modifying the objectives as required. Thus for effective water quality management one needs to be able to predict the effects of various pollution abatement alternatives upon the observed quality of the river.

One important quality parameter is the amount of dissolved oxygen in the river. A major portion of most pollution effluents is comprised of organic material which is used by the microorganisms in their metabolic processes which in turn use up the dissolved oxygen in the river. Previous research has shown that these processes can be described by linear differential equations. A digital computer simulation program has been written and is being debugged which uses these differential equations to predict the effect upon dissolved oxygen at any point along the river caused by each individual source of pollution. Historical data is being used to validate the prediction capability of the model. Once operational, the model will be used to calculate the following coefficients:

f_{ik} = proportion of the dissolved oxygen deficit at point i on the river caused by the k^{th} pollution source.

Let d_i be the maximum allowable dissolved oxygen deficit at point i on the river and X_k be a variable representing the amount of pollution the k^{th} source should be allowed to dump in the river. Let $C_k(L_k - X_k)$ be the cost of reducing the pollution at the k^{th} source from the current amount L_k to X_k. Then the problem of finding the pollution abatement plan which minimizes costs while maintaining desired dissolved oxygen levels can be expressed as the following mathematical programming problem

$$\text{minimize } \Sigma\, C_k(L_k - X_k)$$

$$\text{subject to } \sum_k f_{ik}X_k \leq d_i \quad \text{for each } i,$$

$$O \leq X_k \leq L_k \quad \text{for each } k.$$

Prof. William Bentley, Agricultural Economics, is studying the technology of pulp and paper production and will arrive at estimates of the cost functions $C_k(\cdot)$ for these sources of pollution. James Kerrigan, Water Resources Center, is obtaining estimates of the cost functions for municipal waste loadings. The above model will then be used to study the effects of various alternatives such as low-flow augmentation and mechanical aeration upon cost minimizing pollution abatement schemes.

The above description is an oversimplification of the basic approach being taken. A. MacCormick, Statistics, is developing estimating models of river flow, upon which the coefficients f_{ik} heavily depend. G. Story is analyzing the effect of altering water flow upon the economics of hydroelectric power generation. Dr. Elizabeth David, Agricultural Economics, is studying the economic factors which are not readily converted to dollars. Peter Davis, Law, is analyzing the structure of Wisconsin law as applicable to the design of institutions for water quality management. Prof. Irving K. Fox, Urban and Regional Planning, is generally guiding the project and analyzing the political history of pollution control in Wisconsin. In addition to the above named researchers there are dozens of students assisting in the various phases of the research. In Industrial Engineering, Charles McQuillan is analyzing the applicability of stochastic programming techniques. Jim Frisch and Marc Kaplan are assisting with the testing of the computer simulation program.

EMPLOYMENT SERVICE MATHEMATICAL PROGRAMMING PROBLEM

The employment service problem is to recommend interviews between job candidates and job openings. The problem can be expressed mathematically as follows:

Let X_{ij} = 0,1 depending on whether or not an interview is recommended between the i^{th} candidate and the j^{th} job opening.

U_{ij} = the value of recommending an interview between the i^{th} candidate and the j^{th} opening. (Prof. G. P. Huber has been working on measuring these U_{ij}.)

Let $O \leq a_i \leq b_i$ be integers reflecting the minimum and maximum number of interviews to be recommended to the i^{th} candidate. Similarly $0 \leq c_j \leq d_j$ are integers giving the minimum and maximum number of interviews for the j^{th} job opening. The following mathematical programming problem is known as diophine or 0-1 programming:

$$\text{maximize} \sum_{i=1}^{m} \sum_{j=1}^{n} U_{ij} X_{ij}$$

Subject to

$$a_i \leq \sum_{j=1}^{n} X_{ij} \leq b_i \qquad i = 1, \ldots, m$$

$$c_j \leq \sum_{i=1}^{m} X_{ij} \leq d_j \qquad j = 1, \ldots, n$$

$$X_{ij} = 0,1.$$

A seeming small problem, 9 candidates and 9 jobs, ran for 20 minutes on the 3600 using IBM's Lemke-Spielberg algorithm without arriving at the solution. Another solution algorithm uses the simplex algorithm of linear programming to arrive at initial approximate solutions. However, the number of iterations required to solve the linear program exceeds a reasonable maximum. Mike Grigoriadis and Pat Nanda have adapted a network flow algorithm for solving this problem but there is no computational experience. Professor Falkner is developing a transportation type algorithm which hopefully will be efficient.

Randy Trost, Wisconsin '67

"I never feel like a rookie"

"Sure it's my first year with B&W, but I've been too busy to think about that. I've been working in my field all along, and the training sort of blends right in."

If Randy Trost sounds like a B&W booster, you should hear what his supervisor says about him.

We're looking for aggressive, talented young engineers like Randy. We want you if you want significant responsibility from the start. In fact, we need more engineers than ever before. That's because we're growing faster. Sales were $560 million last year. Up 17 per cent.

That's how it's been from the beginning. We started out making steam generation equipment. That led to atomic power stations, nuclear marine propulsion equipment, refractories, specialty steel, machine tools, computers, and closed-circuit TV. (And we still make the best boiler in America.)

If you'd like to talk with Randy Trost about B&W, call him collect at our facility in Lynchburg, Virginia, AC 703 846-7371.

In the meantime, be on the lookout for the B&W recruiter when he visits your campus.

The Babcock & Wilcox Company, 161 East 42nd Street, New York, New York 10017.

Babcock & Wilcox

A group of prohibitionists looking for evidence of the advantages of total abstinence were told of an old man 102 years old who had never touched a drop of liquor. They rushed to his home to get a statement. After propping him up in bed and guiding his feeble hand along the dotted line, they heard a violent disturbance coming from another room—furniture being broken, dishes smashed, and the shuffling of feet.

"Good heavens, what's that?" gasped a committeeman.

"Oh," whispered the old man as he sank exhaustedly into his pillow, "That's Pa, he's drunk again."

° ° °

THE NEW INCOME TAX FORM

a. **How much did you make last year?**

b. **How much do you have left?**

c. **Send b.**

° ° °

In Hungary, a commissar asked a peasant how the potato production was coming along.

"Oh, fine," answered the peasant. "We have so many potatoes that if we put them in a pile, they would reach clear up to God."

"But, you know there isn't any God," replied the commissar.

"Well, there aren't any potatoes either," said the peasant.

° ° °

Sign on door of doctors' offices:
Dr. Tom Smith, Psychiatrist
Dr. Tim Jones, Proctologist
Specializing in Odds and Ends.

° ° °

He: "Pardon me, but you look like Helen Brown."

She: "Yeah, and I don't look too groovy in blue either."

° ° °

Censors: People who inhibit the earth.

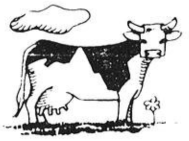
° ° °

Employer: "Are you looking for work, young man?"

Engineering Student: "No, but I would like a job."

How to keep a cow's mind on milk. Instead of flies.

An informal report on a few current projects at Shell. Some of them might seem like offbeat work for an oil company. But this is a company that contributes broadly and significantly to society. A company of experts that brings out the best in its engineering, scientific and business people.



Shell scientists have come up with a vast improvement over even the most talented cow tail. It's called VAPONA® insecticide. A plastic strip impregnated with it will kill flies in a cow stall for up to three months. And VAPONA® insecticide combined with CIODRIN® insecticide keeps cows fly-free 24 hours a day—even out in pasture. Give you ideas for further applications?

Energy from under the sea

Shell is heading into ever-deeper water in the search for oil and natural gas. Recently we designed and installed permanent drilling/production platforms as tall as a 34-story building, with still bigger structures in the works. And we are operating in considerably deeper water from floating platforms. We are also searching on land in 16 states to help meet burgeoning energy needs.

Digestible detergents

The main trouble with detergents is they don't go away. They pollute streams, make fresh water foamy. The solution: detergent compounds that organisms can consume. These "biodegradables" clean clothes just as effectively, but keep streams free of detergent foam. Elsewhere in the chemical part of our business, Shell research has resulted in a wealth of plastics for home and industry, and fertilizers to alleviate food shortages.

The name of the game

More gasoline per barrel of crude oil delights engineers, scientists and conservationists alike. Our new hydrocrackers actually produce *more* than a gallon of refined product from a gallon of feed stock. And we are using sophisticated techniques to tailor-make products by reassembling hydrocarbon molecules.

The pursuit of excellence leads Shell into a variety of fields, both on and off the beaten track for an oil company. If you have a more-than-one-track mind, a desire to explore, to pit your skills against many kinds of problems, there could be a place for you in Shell.

Perhaps your training in engineering, science or business can contribute to tomorrow's new developments. For information about openings throughout Shell sign up at the placement office for an interview with our representative. Or write to Q. C. Stanberry, Recruitment Representative, Dept. E, The Shell Companies, Box 2099, Houston, Texas 77001.

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An Equal Opportunity Employer

EXPO

• 1969 COLLEGE OF ENGINEERING EXPOSITION

by Mary Ingeman

This is the second in a series of articles about the 1969 Engineering Exposition, April 18 through 20, on the University of Wisconsin Engineering Campus.

Each year, as the Exposition becomes bigger and attracts more and more industrial exhibits, there is the increasing feeling that the individual students have lost interest, indeed, lost a part in, their own exposition.

Part of the problem lies in the time students have left to spend on projects of this type. Many people may be interested, but have too much course work to leave time for a project.

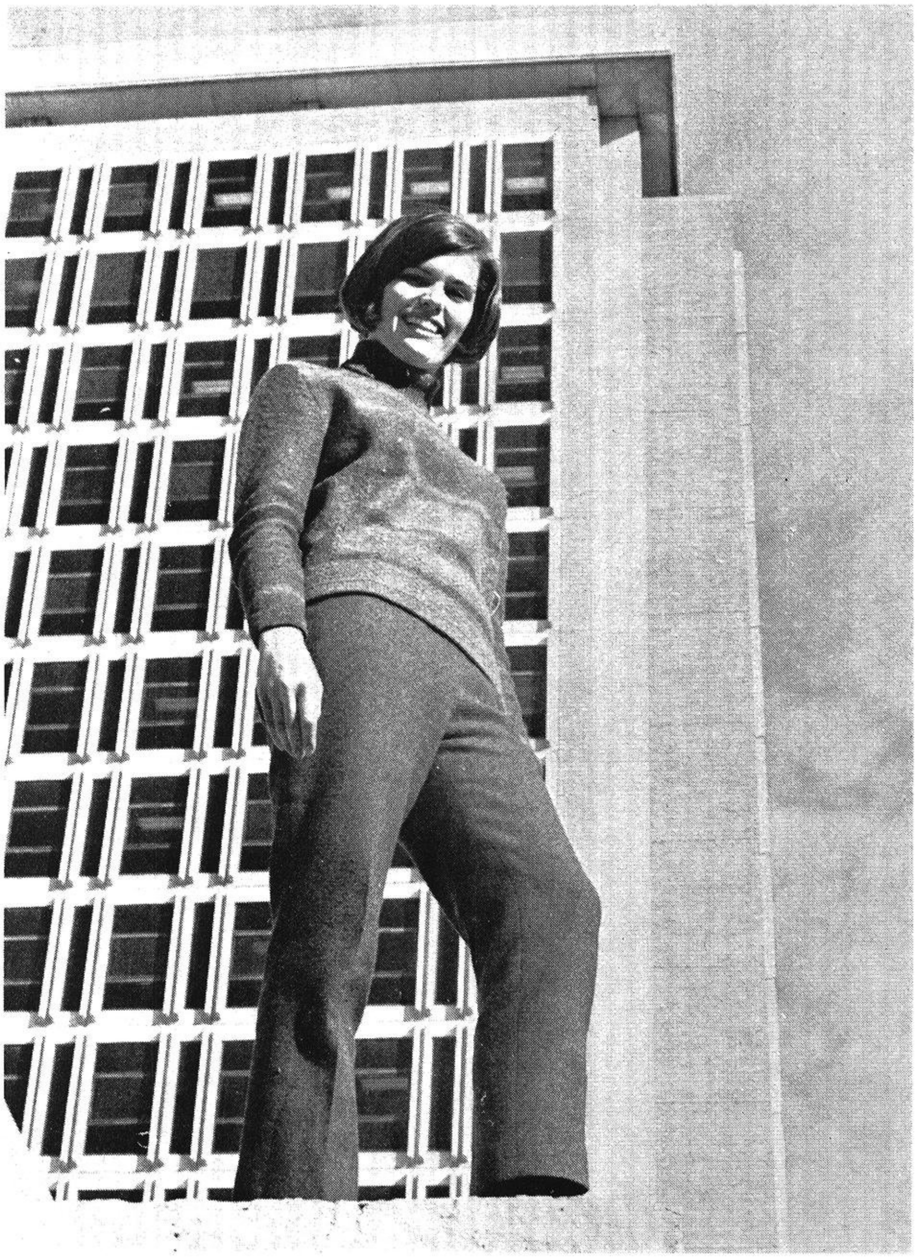
This year the exhibits committee is trying to find a solution. After discussing various propositions with the faculty, and talking with the Dean, the following plan has been proposed:

> *Any student may work on a project or demonstration for the 1969 Engineering Exposition. Under the counsel of a professor in the appropriate department, the student may earn 1 to 3 credits under his department's 699 program. A student may register for these credits by having his advisor and the professor sign "Add" cards. These cards may be left with the registrar any time from now until Feb. 14, 1969, the last day to add courses for the second semester. There are no intended restrictions on what your exhibit may be, only that you must work with a professor and, together with him, decide the number of credits that the work will be worth, and the scope of the project.*

We encourage all types of exhibits in this Exposition, realizing that some people are not interested in original research, and others are not interested in demonstrating basic principles. There are many departmental research projects that could, and should, be displayed. There is also a wealth of new equipment in the labs and research facilities that is complex and would take skill and imagination to demonstrate effectively.

Also, there is no limit on the number of people who may work on one project, only that to get credit, it must have the approval of the professor and the advisor for each person.

While we hope it won't be necessary, we realize that you may become bogged down with work and not be able to complete your project. These credits, therefore, may also be dropped up to three weeks prior to the Exposition. But, after that, part of the prerequisite for receiving your grade is that you must display an exhibit in the Exposition.



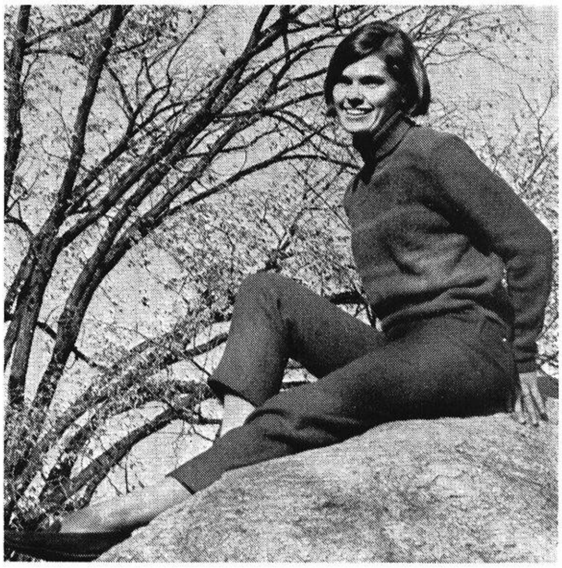
Though the cool blustery winds of November lock the land in winter, Cheri Rhodes warms our hearts with her friendly smile. Cheri hails from Winneconne in northern Wisconsin, where her father is a mechanical engineer.

She will graduate in June and presently plans on being a Hydro-Geologist, one of those persons who carries a divining rod instead of a slide rule.

Cheri loves to take part in all outdoor activities, especially swimming, motorcycling, and looking for water. Of course, rock climbing comes naturally to a geologist and Cheri is no exception.

Any volunteers for a field trip, or perhaps an expedition? Cheri would certainly make a terrific leader, don't you agree?

photos by Bruce Pease



wisconsin's finest
Cheri Rhodes

$$3.54V_b = 3V_a + 2.12V_b$$

$$1.42V_b = 3V_a$$

$$V_b = 2.1V_a$$

So, if these were the facts of the case, the engineer could prove that vehicle B was traveling over twice as fast as vehicle A. Thus, if the driver who is accused of being at fault is going at the speed limit, say 25mph, the other driver was going at least 50mph. No court would judge that he had any right-of-way in a 25mph zone!

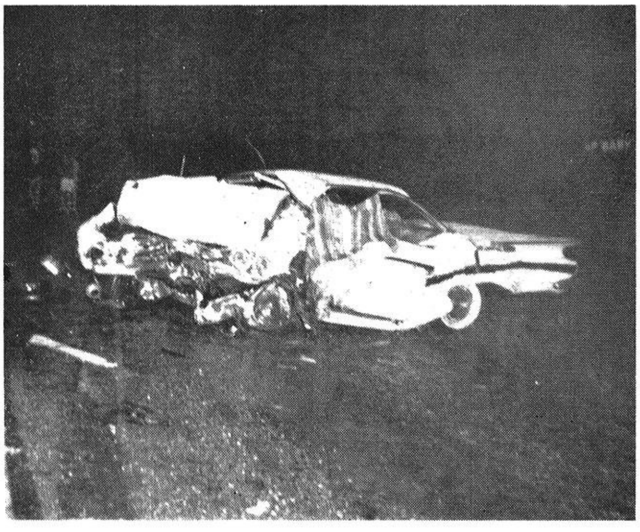
THE PHYSICAL EVIDENCE

The "scene" of an accident is defined as the actual location of the accident, with the vehicles still in their collision positions. The engineer rarely visits the scene of the accident. The "site" of an accident is the location after all has been cleared away. The engineer often visits the site of an accident. Since the engineer does not personally observe the accident scene, he must rely on the observations of others. These observations usually take the form of physical facts which are written in the accident report or can be identified in photos taken of the accident. The engineer may find the testimony of witnesses helpful, but he must remember that such testimony is, at best, only opinion, and at worst, deliberately false.

The accident report generally includes a sketch showing the final positions of the vehicles, along with such things as skid marks, gouge marks, or scratches that might be significant. This is sometimes the only information about the accident that the engineer has available. A word of caution about skid marks: police officers often give the total length of the skid marks, which is longer than the true skid distance by the length of the wheelbase of the vehicle that made the skid. If this is suspected, it is necessary to ask the police officer about it, although usually the sketch will show where the measurement was made.

Gouge marks that are deep and short generally mark the point of impact. This is because rapid deceleration, which usually accompanies an accident, pitches the vehicles severely, an effect like that experienced in hard braking. For instance, in a head-on crash, the bumpers and front frame members often leave deep gouges in the pavement. Headlight glass and underbody dirt will also identify the point of impact. Unfortunately, people trying to be helpful will frequently clear the roadway of such debris before it can be noted or photographed by someone who realizes its significance.

Figure 3



Shallow scratches, coolant, lubricants, and battery acid on the pavement after the accident generally mark the path of the vehicles from the point of impact to the final positions. If the engineer is consulted soon after the accident, he may be able to verify the more permanent points of evidence by examining the accident site.

Generally, photographs are taken at accidents serious enough to call for an engineering analysis. Photographs are used to substantiate police reports and to supplement them. Often evidence is seen in the photos which is not given in the accident report. Most important, though, are pictures of the vehicle damage, especially if it is impossible for the engineer to examine the vehicles personally. Damage to the vehicles indicates their orientation with respect to each other at impact and is used in estimating the velocities of the vehicles just before collision.

If there are no photos of the damaged vehicles or if the photos do not clearly show the resulting damage, the engineer must inspect the vehicles himself, if at all possible. In addition to observing the damage, the engineer looks for paint transfer and tire marks on the vehicles.

Medical reports concerning the injuries to the occupants of the vehicles are sometimes used to determine the direction of the crash. A chest injury to the driver would indicate a head-on type of collision, since evidently he was thrown onto the steering wheel.

When an engineer visits an accident site, it may be weeks or months after the accident. Such things as elevation, curvature, coefficient of friction, and view obstructions are often determined at the site. The services of a professional surveyor are often very valuable for these tasks.

To illustrate engineering analysis of accidents, two brief examples will be discussed. They show two extremes in the types of cases that arise.

EXAMPLES

These example cases are based on actual accidents that Prof. A. H. Easton of the University of Wisconsin has analyzed. Professor Easton has been analyzing accidents since 1947 and has been consulted in over 400 cases.

The first case is a straightforward application of engineering principles. A Buick collided head-on with a truck. Before colliding, the Buick left 97 feet of skid marks on dry, but heavily traveled, concrete pavement. The vehicles came to rest, essentially at the point of impact, and it is established that the truck was either stopped or barely moving when the collision occurred.

The question is, how fast was the Buick traveling when its brakes were applied?

As with most accidents of this type, the assumption is made that the driver applied his brakes to the point of skidding as soon as he saw impending danger. Any driver who has faced a panic situation knows this is a valid assumption. Thus, the skid marks show the total distance for which the brakes were effective. Momentum is not a useful consideration in cases of this type, where one vehicle is many times heavier than the other, because it tends to give inaccurate solutions. Further, in this case, there is no data that would make a momentum calculation possible. This is a problem for the conservation-of-energy method.

To find the energy of collision requires that the damage to the Buick be compared to the damage done in crash tests or certain accidents where the energy is known. Professor Easton estimates the crash speed to be 20 mph. This is much less than the inexperienced person would guess. The reason for the low speed is that the Buick's frame went under the truck and was not damaged. Sheet metal itself takes little energy to deform. The energy expended in damaging the truck is negligible. The energy of collision is then:

$$E_{col}=WV^2/30=W(20^2)/30$$

The coefficient of friction must be determined before the energy in skidding can be calculated. The best way would be to make tests at the accident site. If it is impossible to make tests, the engineer could estimate from experience what the coefficient of friction is, based on the description of the surface. A figure of 0.65 would be a good approximation in this case. Thus the energy of sliding is:

$$HEAT=\mu Nd=0.65(W)(97)$$

When the sum of the sliding and collision energies is equated to the initial energy before braking, the initial velocity is determined.

$$WV^2/30=W(20^2)/30+0.65(W)(97)$$
$$V=48mph$$

Note that the weight cancels out of this equation, so that it is irrelevant in this case.

This example has an interesting sidelight. The accident happened on an open highway, so the Buick's velocity was not excessive. If the Buick driver had eased off his brakes so that the tires would have rolled instead of skidded, he could have very easily avoided collision by steering away from the truck. But as it was, he kept the brakes firmly clamped, thus making the car completely unsteerable and it slid straight into the truck.

The second example is a far more complicated case and shows the importance of experience. It is a case where there are no witnesses who can tell anything about the accident. Figures 3 and 4 show the vehicles in their final positions and the damage they sustained. Notice that the road is wet from rain and notice also that the Buick's front sheet metal is torn off and that the engine is missing.

The Buick engine came to rest in a cornfield on the side of the road, opposite from where the Buick vehicle finally stopped. There were gouge marks and scratches in various places on the highway and parts from the vehicles were spread in all directions. This is not a complete summary of the data, but at least it gives some idea of the case. The problem was to reconstruct the accident.

The general consensus of those investigating the accident was that it had to be a head-on collision. This was because the highway was straight at the accident site, and there were no intersecting roads. But the damage to the Buick is not characteristic of a head-on collision, especially since the bumper was still intact. Professor Easton concluded that the only way for the physical evidence to have occurred was that the Buick experienced a sideways slide, the cause of which is unknown. It slid partially into the lane of the Chevrolet, which caught the Buick in such a way as to dislodge the firewall and engine. These parts were thrown from the vehicle as it spun violently in reaction to the blow from the Chevrolet.

This case also illustrates the difficulties that can occur in court when an analysis such as this is explained. In cross-examination, the lawyer asked questions like, "If this scratch had not been present, could you still say that the Buick invaded the lane of the Chevrolet?" His purpose in asking these questions was to find what evidence was vital to the analysis and then argue that this evidence was not fully established. An expert subjected to this treatment must be on his guard to avoid being tricked into saying something that he would not say if he had more time to think about it. Starting with the basic principles of energy and momentum, the engineer must add a tremendous amount of practical knowledge if he is to become a successful expert in automobile accidents.

Figure 4

JOKES

Federal aid is like giving yourself a blood transfusion in your left arm, drawing from your right arm and spilling 90 percent of it on the way across.

° ° °

A Texan had a small farm with just a few sheep. One day his wife, while dyeing some bedspreads blue, had a little lamb fall into the bucket of dye. A passing motorist saw the lamb with the blue fleece and bought it for $50. So the Texan figured he had a good thing going and colored some more lambs which brought big profits.

"Pretty soon," he recalled, "I was coloring them pink, blue, yellow, and green and you know—now I'm the biggest lamb dyer in Texas."

° ° °

"We've got a case of beriberi up here. What'll we do with it?"

"Give it to the Engineers. They'll drink anything."

° ° °

Butler: "Sir, there's a woman peddler at the door."

Codger: "Excellent, Godfrey, we'll take two."

° ° °

Mrs. Worthmore and French poodle were shopping one day when she noticed an E.E. standing next to her who was looking fearfully at the puppy frisking about his legs. "My, my," she said, "don't be afraid of Felix; he won't bite you." "Madame," said the man, "I wasn't afraid he'd bite, but I noticed him lifting his hind leg and I thought he was going to kick me."

An engineer is a person who measures with a micrometer, marks with a piece of chalk, and cuts with a dull ax.

° ° °

A man walked into a tavern and sat down at the bar. His dog followed him in and jumped up on the stool next to his master. The bartender came over, gave the dog a dirty look, and asked the customer, "What'll you have?"

"Two beers."

"The two beers for you?"

"No, one for my dog."

"Oh! He drinks beer?"

"Yep, and not only does he drink beer, he speaks too."

"Well, then, you get him to say something and the drinks are on the house."

"It's a deal." Turning to the dog he asks, "What's on top of this house?"

"Rr-r-ruf."

"That's right!"

The skeptical bartender snorted his disbelief.

"All right, have the mutt say something else for another round."

Turning to the dog, the stranger asks, "What's on either side of the fairway on the golf course?"

"Ruff-ruff."

"Right again," laughed his owner.

The angry bartender leaned over the bar, grabbed the customer by the shirt and snarled, "All right wise guy, I'll ask the dog a question and no funny answers or I throw you both out in the gutter. Turning to the dog, the bartender called out: "Who is the greatest player in baseball history?"

"Rr-r-uth!" barked the dog.

With that the barkeeper jumped over the bar, grabbed the dog by the scruff of his neck, the man by the collar, and heaved them both into the street. Whereupon the dog looked up at his master and said, "I wonder if he thinks Mantle is better than Ruth?"

° ° °

A modern country is one which bans fireworks and produces H-bombs.

° ° °

A small college opened up in the Midwest and when the first semester began the college president discovered that there was not enough room in the dormitory for all the students. So the president decided to quarter the male students and the coeds in the gymnasium. Since there was no time to put up a partition, he painted a heavy white line down the center of the gym. Then he told the students: "If any of you crosses the white line into the side of the gym that belongs to the other sex, you will be fined $5 for the first offense, $10 for the second offense, $20 for the third offense, and so forth. Are there any questions?"

"Yes, sir," one of the male students asked promptly. "What's the rate for a season ticket?"

° ° °

One of today's greatest labor saving devices is tomorrow.

° ° °

(continued on page 39)

Top grades as a kid, to get into college. Then the matter of survival through four or five years of engineering study. Soon, with luck, the battle will be won. A full-fledged engineer has been created,

ready to serve

the boss!

AND HE HAD BETTER BE READY FOR YOU. Bosses who think like caricatures lack the capacity to run important operations that call for the brightest operating talent that a stepped-up educational system turns out. The new talent that may or may not choose to make itself available takes a careful look at the carrots being offered.

Once we decide we like that bright new talent—and we decided that quite a while ago—it becomes necessary to put up with their demands. Aside from the expected attractive package of salary, benefits, and advancement plan, the ones we have chosen to chase often demand in addition an opportunity to try their newer and subtler ways of thought against old problems. As it happens, we need this type badly, because we have plenty of stubborn old problems, plenty of financial incentive to crack them, and a very stable platform for launching new ventures that take a little while to pay off. (The latter must not be underrated as an attraction.)

Sweeping generalizations are no more reliable for the Class of 1968 than for the boys of '38. Not all '68's finest engineering minds disclaim knowledge of how to handle a screwdriver nor shun empiricism. We offer excellent carrots, along with money, to engineers with a knack for making things work even when they can't explain why.

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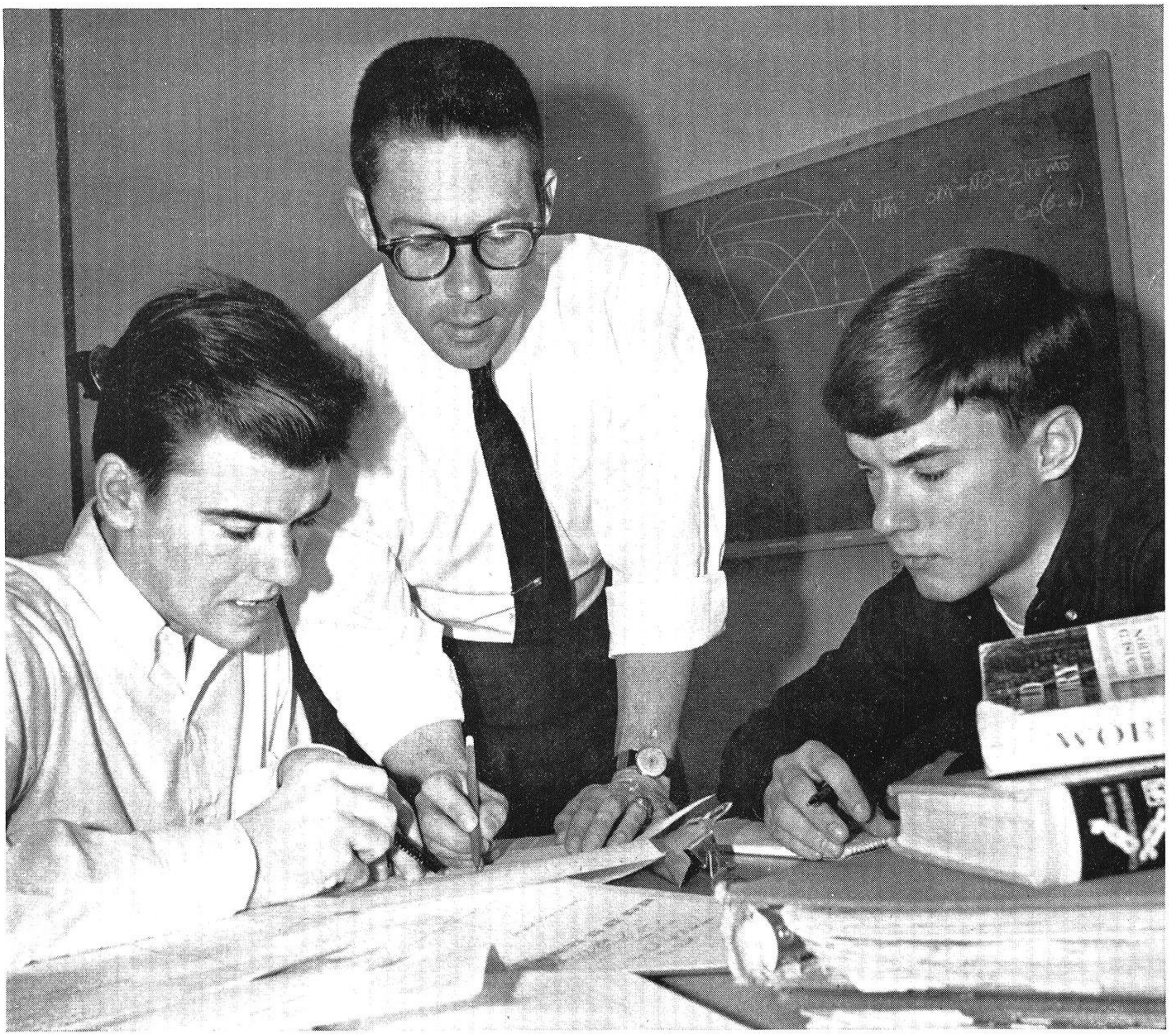
Business and Technical Personnel Department
Rochester, N. Y. 14650

We seek mechanical, chemical, industrial, and electrical engineers. In Rochester, N.Y., we make photographic and non-photographic products. In Kingsport, Tenn., our Tennessee Eastman Company makes fibers, plastics, and industrial chemicals. In Longview, Tex., our Texas Eastman Company does petrochemistry, and in Columbia, S. C., our Carolina Eastman Company has a new fibers plant. Everywhere we offer equal opportunity to all and geographical stability to those who want it.

Kodak



Pete Drobach has a knack for getting to the root of a problem.

High school students John Magish and John Ripley would be the first to agree.

They're both student members of a "big brother" program that Pete sponsors. Each week, they spend several hours of their own time helping less advanced classmates with their studies.

Pete is more than a sponsor. He's also a consultant—particularly when they're stumped by the logic of a tough "new math" problem.

But when Pete graduated from Rutgers in 1964, it wasn't these youngsters with their homework problems that brought him to General Electric. It was the chance to help people in industry solve tough technical problems. A career in technical marketing at General Electric gave him the opportunity.

Today, Pete's an application engineer in steel mill drives and automation systems. His ideas on how to apply products from many of GE's 160 separate businesses enable his customers to improve the efficiency and productivity of their plants.

Like Pete Drobach, you'll find opportunities at General Electric in R&D, design, production or marketing that match your qualifications and interests. Talk to our man when he visits your campus. Or write for career information to: General Electric Company, Room 801A, 570 Lexington Avenue, New York, N.Y. 10022.

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