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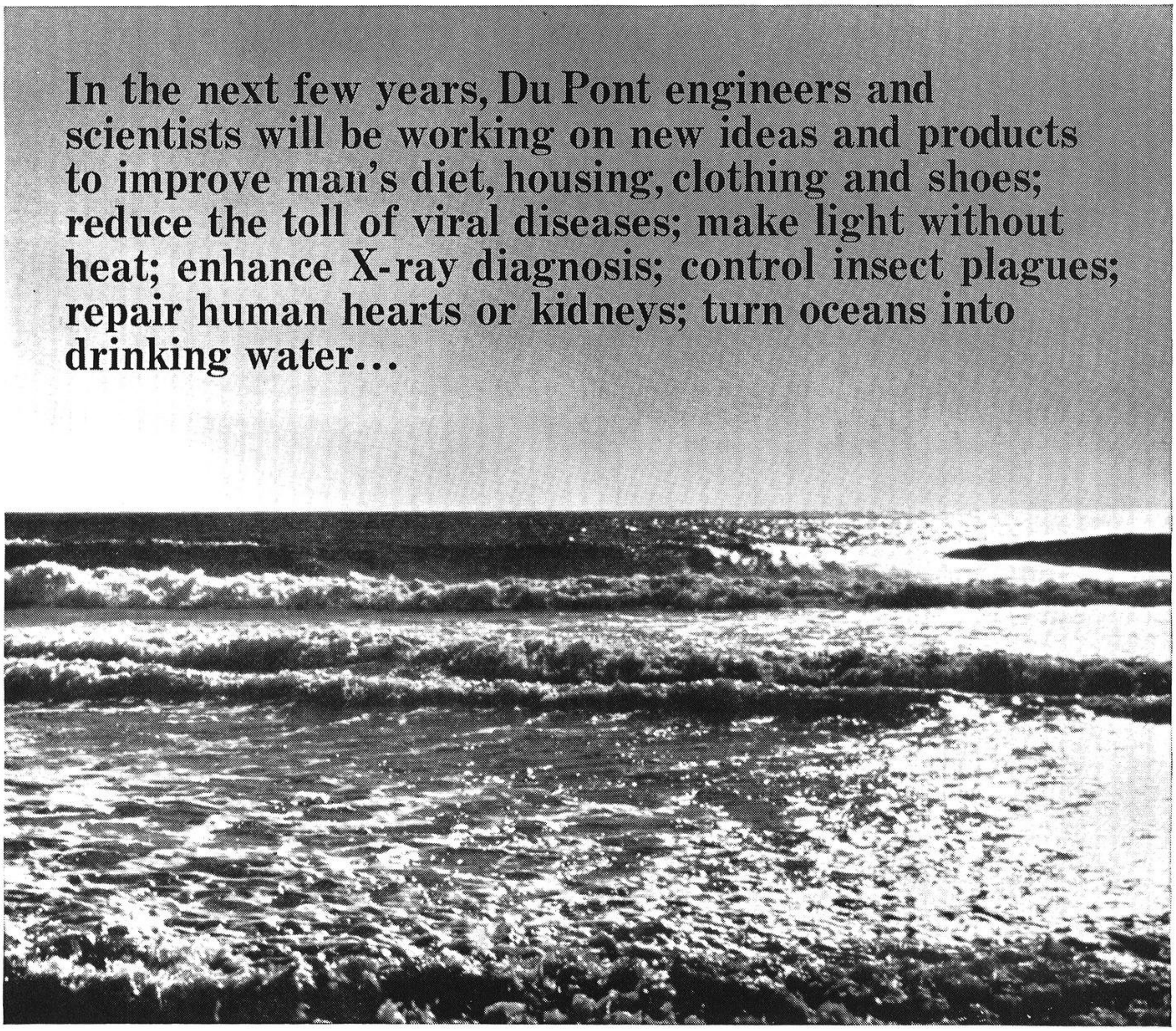
VOL. 72, NO. 6 MEMBER ECMA 35 CENTS MARCH, 1968

monorails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wisconsin engineer

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EDITORIAL

Whose Principles?

The placement office question has precipitated so quickly that there is barely time to get out a statement before the meeting will be over and the answers will be a matter of record. But *The Wisconsin Engineer,* for one has been deeply disturbed by the events of these past weeks and by the apparent extreme lack of communication between the colleges of the University.

As far as we can see, there is no question that the placement office forms an integral part of the engineer's education. Rapid advance in science and technology requires men who enjoy their work, who really want to do what they are doing. Over 600 companies interview engineers on this campus, offering the student on-the-job experiences during the summers, as well as permanent employment. This summer experience, or similar co-op programs with industry, provide the engineer with experience to shape his thinking and direct his education so that he enters a field he enjoys and that he can contribute to. This is equivalent to an intern program for a doctor.

Assuming that we agree that the placement service is necessary, many opponents will contend that these interviews should be held off campus. This is a fine idea in principle, but practically it is impossible. In the first place, this was the situation 20 years ago — and it was so abused by both companies and students that the faculty drafted special resolutions requiring companies to interview *on* campus. You may say, "but this could be controlled," and perhaps it could be *now,* but what engineer today isn't taking over 16 credits a semester in a vain attempt to graduate in 4 years? This can mean up to 25 class hours a week, or maybe 7 different courses. There is no time for assorted trips down to the Belmont Hotel.

Then we have the moral issue of the placement office — is the University failing to remain politically neutral? I say that only by letting *every* company come and interview can we be truly neutral, allowing a complete exchange of views on all sides. In this way intelligent students will get to confront businessmen with their views and ask them about their companies' moral positions. This is not possible by letter! Despite President Harrington's recent opinion that engineers need to learn how to make decisions, I feel that most, if not all, of the engineers use these interviews to great advantage as the start of a decision-making process that continues throughout their lives. Certainly the countless advances in all phases of science and technology have come not from the L&S group, but from the *decisions* of engineers and scientists. The moral decision on working on a "war project" belongs to the individual after he has had a chance to think about and discuss these matters — if he *wants* to discuss them. And in this modern society, what company, or University, is not involved in the war effort?

Lastly, no resolution is any good without recognizing and dealing with the heart of the problem — the very real threat of violence on this campus. The College of Engineering faculty and Dean Wendt are on record as supporting the total right of free speech as long as it does not obstruct or violate the rights of others. We agree! Chancellor Sewell recently said, "A petition isn't a very good way to run a University." It is hard to believe that the petition isn't a better way of expressing one's views and the strength of these views, than riots and open threats of force. It seems that the threat of violence has turned this issue not into a question of right and wrong, but into a game of pass-the-buck until the interviews are in some out-of-the-way place where the city police will be free to use tear gas or whatever else they feel necessary to keep "order." And chances are this "order" will be far less liberal than that which the protestors are enjoying now.

Our position? That the engineering placement office is a vital part of the engineer's training and should *not* be run by the whims of the students who view business

(continued on page 38)

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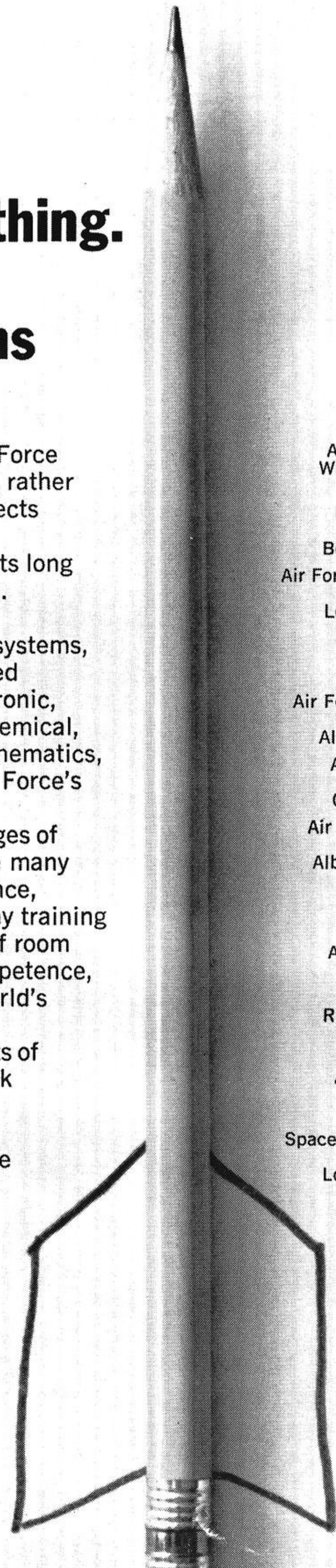

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LETTERS

→ FEEDBACK ←

I note with interest your editorial in the January, 1968 *Wisconsin Engineer.*

Students are concerned about many aspects of the organization and administration of the educational system these days. They want a voice in the system. I believe you have pointed to a place where the undergraduate could and should make a contribution.

You may be aware that a committee on the Teaching Assistant System has been functioning on the campus for some time. Faculty Document No. 183 has been prepared for presentation at a Madison campus faculty meeting on February 5, 1968. This 23-page document will be available in departmental offices for distribution to TA's. You might wish to examine a copy and decide what contributions might be made by yourself or your colleagues to the continuing dialogue by which we of the faculty attempt to develop a better system.

Sincerely yours,
Merton R. Barry, Director
Engineering Foreign Programs
651 University Avenue
Madison, Wisconsin 53706

Following are some excerpts from the report of the Committee on Teaching Assistant System mentioned in Mr. Barry's letter. We feel this report contains many valuable suggestions and desires careful review by all concerned.

The actual recommendations fall into four basic categories. The first concerns *The Selection and Funding of the TA.* Here we confront the major problem of TA quality by suggesting an ultimate restructuring in the funding and training of all graduate students, together with a more immediate step that would be a major change in itself. The remaining three categories of recommendations are only slightly contingent upon the first. The second group of recommendations involves the *Orientation, Training, and Supervision of TAs,* while the third concerns aspects of *The Teaching Situation* itself. Finally, the fourth and last cluster of recommendations treats the need for improved *Channels of Communication and Continued Specification and Review of TA Policies.* Here the committee will suggest several ways to eliminate current ambiguities and to insure proper vigilance on further problems as they arise.

The committee feels that there are basically two possibilities for improving the quality of TAs in the many departments where improvement seems imperative. First, the University might radically re-style the teaching assistantship to make it more alluring than other funding alternatives. The TA might be given far better pay, greatly enhanced prestige, and many more faculty rights and privileges when compared to either the RA or the Fellow.

As a long range goal, the University (and departments within it) should make every effort to develop programs in which graduate students would be guaranteed financial support for extended periods (normally four years), provided, of course, that the student shows continued high level performance and good pace toward the Ph.D. A funded student would be expected to spend time as a teaching assistant, a research assistant, and on fellowship at various points during his graduate career. The specific timing would depend on the student's abilities and needs determined in consultation with the major professor, and would also depend on departmental needs and resources. The program would have to be flexible, so that it would be adapted to the different conditions in the various departments. Let us be clear on what is intended. Instead of having some students enter graduate school and continue as either Fellows, RAs or

FEEDBACK

TAs, the requirements and amount of support would be basically the same for all funded students, thereby eliminating current distinctions that are often invidious and sometimes depend more upon outside evaluation of undergraduate than graduate performance.

The proposal is meant to insure that the best students will do some teaching; it is not meant to force every graduate student to teach automatically and regardless of capability. Clearly some students — even some very good students — are likely to make poor TAs, whether because of language problems, general difficulties in communication, or intellectual immaturity.

The remainder of this report is addressed to what can be done now while working towards this ideal.

One feasible step has already been taken in several departments and is under serious consideration in others. The committee recommends that *in those departments where it is feasible, teaching experience should be required of every funded Ph.D. student, including RAs and Fellows, at some point in their graduate careers.Departments would have to apply this policy with discretion, since, as discussed previously, there will be some funded Ph.D. candidates who are ill-equipped to teach.*

Not only does it recognize that teaching experience is a crucial part of graduate training, but it also insures that the best graduate students will spend at least some time as TAs so that the undergraduate student can gain in the bargain. Not only would it break down any currently invidious distinctions between TAs, RAs, and Fellows, but it might also reduce the financial inequities. If teaching is required, the TA stipend would be eligible for the tax-exempt status currently enjoyed by both RAs and Fellows.

So far, then, we have focused on several major recommendations and their rationale. But there are other matters that also deserve specific comment in this section. Some of these have already been alluded to without emphasis in their own right. For example, we feel that it is generally wise to reserve teaching assistantships for more experienced graduate students, perhaps ideally for those who have Master's degrees. Again this will be more practical in some departments than in others, and there are no doubt a number of excellent first-year TAs, including some whose enthusiasm more than compensated for their lack of experience. Some 42% of the students and 52% of the faculty expressed doubts about the quality of first-year TAs.

In a similar vein, we also should re-emphasize our conviction that, *under the current system, TAs should be appointed, reappointed, and assigned specifically with regard to teaching ability.* We realize that where first-year students *are* used as TAs, it is difficult to assess their teaching potential accurately. Still, we would urge departments to include the dimension of potential teaching ability in the letters of recommendation requested.

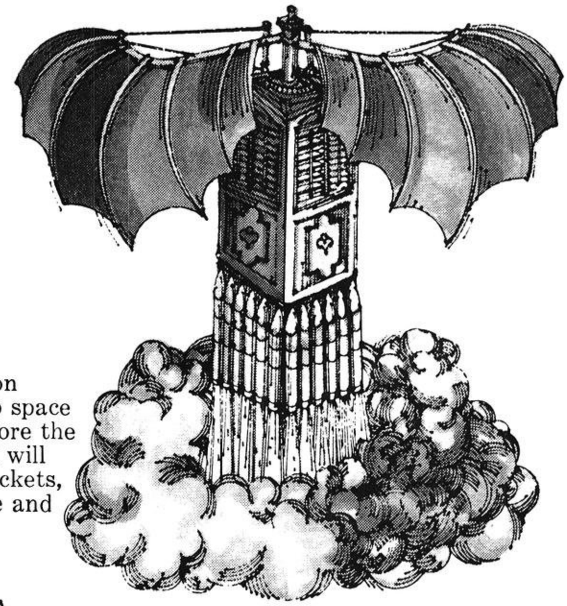
For this reason, the committee *recommends not only that TA rates continue to be raised in line with cost of living increases, but also that as additional funds become available, at least a portion be used for revising salary inequities in regard to differentiated workloads where warranted.* The committee also shares the student's non-financial concerns, and our report now turns to them.

At one point in the questionnaire, we asked the TAs to tell us in their own words what might be done to improve their teaching. Three categories of response were most common. One was no surprise in stressing greater independence, creativity and responsibility—matters to be discussed in the next section. Two others did surprise us in their shared emphasis on more training and supervision. Although the respondents emphasizing independence are not necessarily the same respondents that stressed the need for training (e.g., second and third-year TAs were not as likely as either first-year or former TAs to indicate the need for further training), the two goals of independence and training are not mutually exclusive. Surely both are required in generous measure, and one without the other would fall short of an optimum teaching environment. In any event, it is apparent that most TAs felt that there was something worth learning from their faculty supervisors. Some 70% indicated respect for the teaching ability of the professors they were working with. Although the effort to learn may be especially marked among the four-fifths who reported that serving as a TA had increased their desire to teach after obtaining their degrees, overall only 18% expressed any agreement at all with the cliché that "Teaching is an art you are born with and not a skill you can acquire." The general tone communicated not only a willingness but a hunger to develop that skill further.

Certainly one place to start is with an orientation program before the new TA assumes his duties. This is especially important since some 56% of the current TAs during the Fall semester of 1967-68 were new TAs. Only 15% of our TA respondents felt that they were "very clear" about their specific roles and responsibilities when they began teaching. Fully 74% endorsed such orientations, and most felt that they should be conducted on a departmental basis rather than University-wide. *The committee concurs and recommends a continuation and extension of departmental orientation programs, par-*

(continued on page 33)

They had the right idea.



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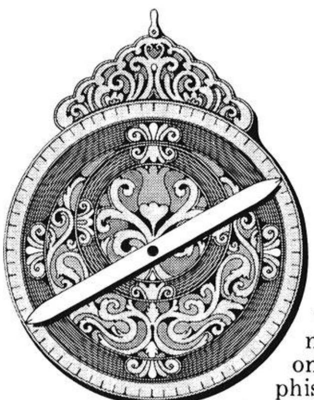

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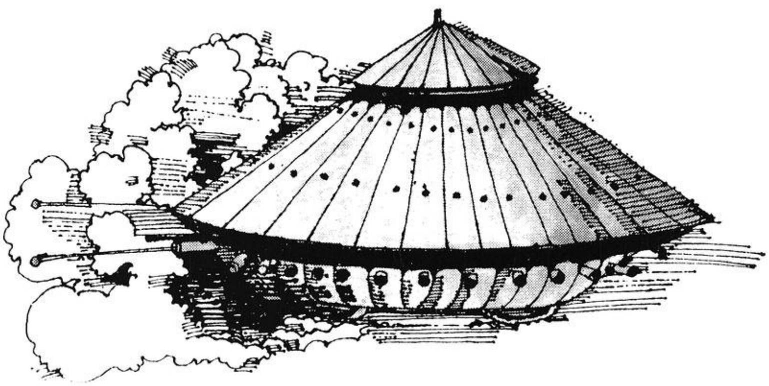

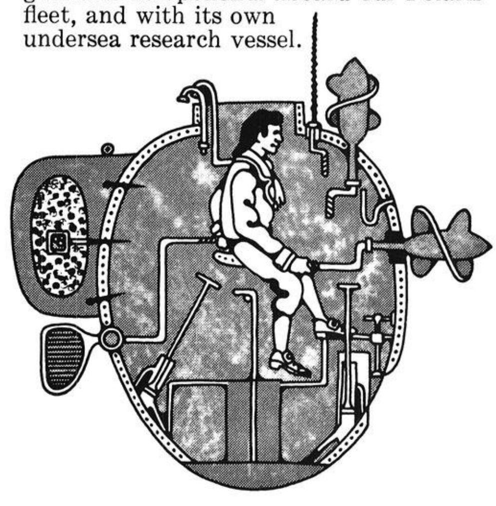

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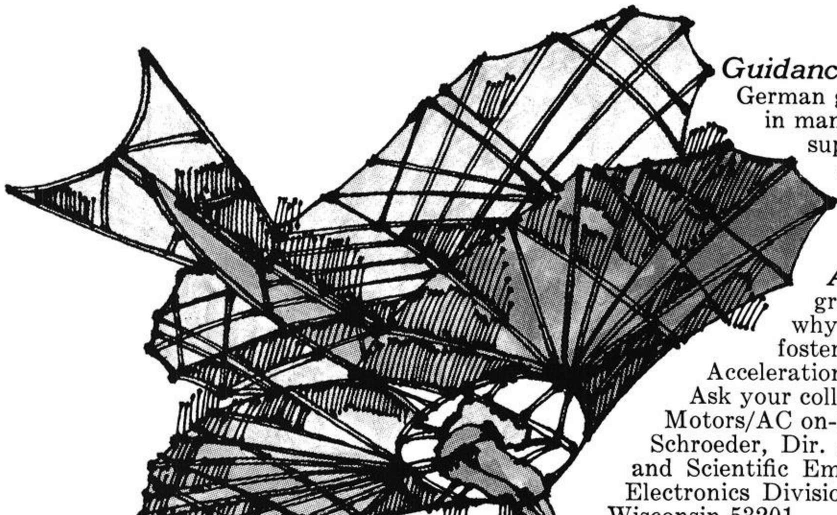

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COVER STORY

Monorails

by Dale Panko
CiE '69

UNLESS something can be done, traffic in the large cities of this country will reach a monstrous impasse by 1980. With increasing mobility of people and the increase in population, intercity travel and commuter traffic will more than triple.

One solution of this basic problem is rapid transit—a method of transporting the millions of people to and from work, or between cities. Rapid transit must not add to existing congestion and transportation troubles. It must be fast, modern, reliable and safe. A rapid transit system must attract and hold patrons who will use it because they WANT to, not because they MUST. Today monorails can solve the rapid transit problem and provide safer, faster, and more reliable service than conventional transport systems.

TYPES OF MONORAILS

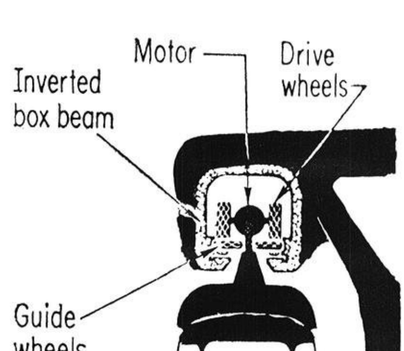
The monorail is defined as a one-track railway, consisting of a single or multiple unit train. It operates on one track, usually a concrete beam, on which the train is either supported or suspended. This is its distinct difference from the conventional railroad which utilizes two rails of steel construction for operation.

In the suspended monorail system, the cars are suspended by means of a hook-like construction which hangs pendulum-fashion from two tandem-wheeled trucks. The disadvantage of this type of monorail, as compared with the supported monorail, is that it is more susceptible to sidesway (lateral movement causing rider discomfort) when rounding a curve or operating during a windy day. This system will be referred to as Type I.

The supported monorail, on the other hand, has its center of gravity above the concrete beam and rides the rail rather than hangs from it. This is a more popular system than the suspended monorail and is used, almost exclusively, by American manufacturers who foresee a future in monorails. The supported system will be referred to as Type II.

Guidance and Balance

Due to centrifugal force while rounding a curve, the car of a monorail tends to swing up as in type I,



The safege suspended monorail.

or tip over as in type II, causing imbalance and possible derailment. To maintain balance and to minimize car sidesway necessitated the use of a gyroscope in the first monorail systems. It provided adequate balance and increased passenger comfort. However, a fear of the gyroscope's failure and the results of such a failure reduced the interest in utilizing this method (although the first monorail system, for instance the Tokyo Transport, still operate on the gyroscopic guidance principle).

It was not until 1952, that a Swedish industrialist, Alex Lennert Wenergren, introduced in Germany the most effective method to maintain continual and fail-proof balance and guidance of monorails, a method particularly useful for the type II system. His solution was for a system utilizing a concrete beam as the track and requiring the trucks on each monorail unit to consist of eight wheels. Four wheels would rest on top of the beam and support the monorail; the other four wheels, two on each side of the beam, would turn in horizontal planes against the beams providing balance and maximum safety in guidance.

This method for guidance and balance has proven to be safer and smoother operating than the gyroscopic method. Guide wheels of the monorail (the pneumatic guide wheels and supporting wheels) are inflated with nitrogen—a gas claiming lower diffusion qualities than air, thus reducing fire risk and blowout occurrences which could result from overheated tires.

To prevent the blocking of tracks and to ensure passenger safety, which is jeopardized by blowouts, the monorails are equipped with hard rubber, steel-rimmed wheels of smaller diameter than the inflated pneumatic tires. The smaller tires are located behind the pneumatic tires and contact the running surface inside the path of the deflated tire immediately after blowout, thus providing continual, safe operation.

Because of their ability to provide a smooth and quiet ride, rubber tires are used almost exclusively for monorails, with the exception of the first monorail systems. In contrast, the conventional railroads which operate with steel wheels on steel rails and cannot claim the quality of ride a monorail is capable of providing.

Characteristics of Present

The major aim in monorail car construction is to reduce the per passenger car weight. The reduction in weight is desirable since horsepower is expensive. For instance, an attempt to reduce the weight of cars to provide efficient use of horsepower can be seen in the conventional transit system. Aluminum bodies and lighter, sturdier frames are being used to provide the same amount of car strength but less car weight. Car weight-to-passenger ratio is even more critical in monorails, because the monorail track structure is very sensitive to weight.

The type II monorail is the most capable of providing a low weight to passenger ratio. It transmits the live load (passenger weight) and the dead load (weight of car itself) to one integral load-carrying underframe. The underframe carries the weight directly to the trucks. This direct transfer of weight, from car to trucks, allows the car's sides and roof to be a secondary consideration and is designed only for passenger safety against collapse and telescoping effects during a collision. The number of reinforcement beams or sideposts is reduced considerably as compared to type I, thus providing more window space and less car weight.

In the type I monorail all of the weight has to be transmitted to the roof which becomes the load-carrying member. To permit this type of weight transfer requires heavy reinforcement beams, increasing car weight and reducing window space. The type I monorail is, therefore, less desirable than type II.

SEATING

The same seating arrangement is generally used in all monorails. The driver's compartment for the type II is located above the front wheel housing. For the type I system the driver's compartment is located above the beamway and is separated from the passengers who ride in the suspended section located below the beamway.

Type of Motors Used for Monorails

The monorail cars designed since World War II are propelled by electric motors. The motor is mounted on the trucks of the monorail car, rather than in the body. The advantages of such a location is maximum starting torque, smooth acceleration, full horsepower utilization, and reduced wheel slippage. Increased rider comfort and economic operation is inherent.

Motors can be of either alternating or direct current type. Direct current is presently being used, due to the wide range of available direct current equipment. Flexibility of equipment and good service promise lower maintenance and operation costs. Alternating current would be used if such a motor could be designed without additional car apparatus. This would reduce monorail cost and eliminate the need for roadside conversion from public utility sources. Since no motor utilizing alternating current can be constructed without additional car apparatus, the direct current system has proved to be most efficient.

ECONOMICS OF MONORAILS

The economics of construction of the monorail as compared to the conventional transit (railroad) varies with the location of the transit system. For instance, the advantages of monorails are far-reaching in terms of bypassing expensive real estate in more populated regions. The monorail requires less right-of-way and less land for operation than a railroad. However, the advantage of a small right-of-way requirement turns into a disadvantage as compared to conventional transit in less populated areas where real estate values decrease. The use of a monorail here would mean unnecessary expense in terms of track girders and supports instead of less expensive ballast and rails required by conventional transit. A San Francisco proposal advised against monorail because of the large percentage of available inexpensive surface right-of-way. This is a very important consideration, one that precludes the use of monorails for city to city transit.

As far as the more economical systems of construction are concerned, proponents of the monorail claim that its lower first cost is a major advantage. Whether or not this advantage exists depends very much upon what one compares with monorails. In San Francisco a comparison of conventional transit with monorails revealed monorail costs were about 3% higher. The San Francisco proposal contemplated a small percentage of subway lines for both sys tems. In Caracas, a comparison showed type II monorail cost to be 40% lower than conventional transit. Here a larger percent of total route was subway. Certainly where subway construction must be used, the monorail is at a disadvantage. Where conventional transit can be built at ground level, both monorail systems are again at a disadvantage. However, where elevated construction can be and should be used, either monorail system may be the economical alternative.

The considerable variation in first cost per mile of several recent monorail proposals can be explained in part by a difference in right-of-way costs and in the difficulty in construction which would be encountered. There is some reason to believe, however, that the more expensive proposals may reflect average conditions more accurately.

RAPID TRANSIT SYSTEMS OF THE PRESENT

Having acquired a basic understanding of the fundamental components, economics, and general operation of the monorails, systems operating at the present can be discussed. There are three types of systems which will be presented in this report. Two are monorails and the other will be referred to as a public transport system which is in an experimental stage in Pennsylvania under the Westinghouse Company. Since the latter is very similar to the supported monorail, it wasn't discussed earlier in the report. The two monorail systems which will be discussed are the Safege, a suspended monorail located in Paris, and the Alweg supported monorail which is widely used in the United States.

The Safege Suspended Monorail

One of the existing types of elevated, suspended system is the Safege system recently constructed be tween Charenton and Creteil in the southeast suburbs of Paris. The present system is 3 kilometers long but an extension of the line has been scheduled and is being currently constructed. The principal reason for the increasing usage of the suspended system is that it can be built quickly and at a cost of about one quarter of that required for other systems.

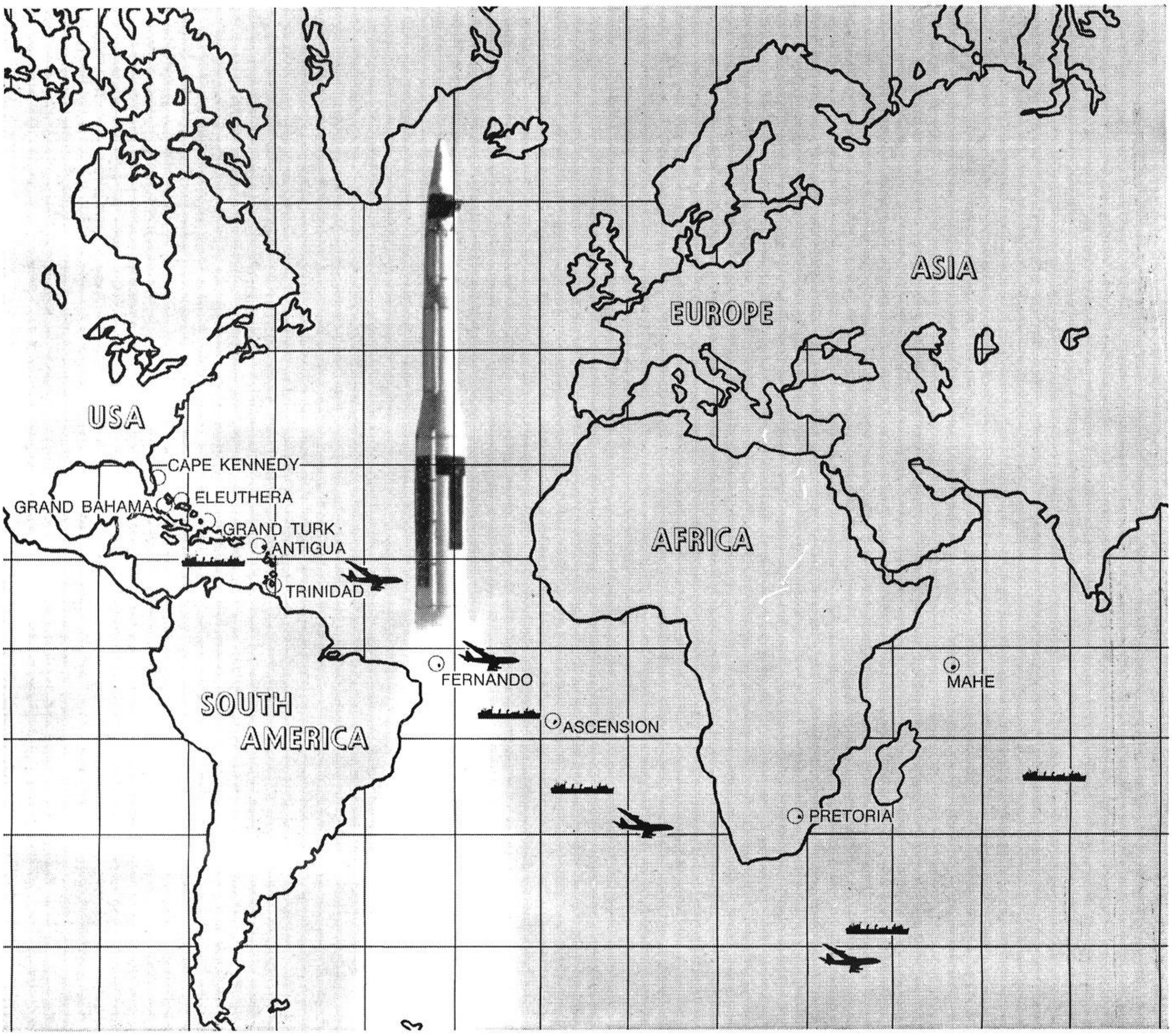
A few of the major advantages of the Safege system are: That the tracks, motor bogies, and conductor rails within the beamway are weather protected; the enclosed beamway together with the use of pneumatic tires provide very silent operation, internally and externally, and the relatively unrestricted conditions under which the bogies run makes the system very flexible. Curves can be of small radius; 100 ft. is possible in sidings and vertical curve of sible700 ft. radius and gradients of ten percent is possible. This allows

(continued on page 29)

SUMMARY OF COSTS

	Los Angeles Monorail	Detroit Monrail	San Fran. Conv. Transit[4]	New Orleans Monorail	Caracas Monorail[5]
Route Length (miles)	45	53.9	123.1	15.8	48.4
Seats/Car	67	67	76	50	50
Load Factor[1]	.45	.45	.45	.45	.45
Passenger Mi/Car Mi.	30.2	30.2	22.5	22.5	22.5
Capital Costs $/Mi[2]	2,820,000	4,700,000	5,800,000[3]	2,060,000	5,800,000
Debt Service $/Mi/Yr[2]	290,000	275,000	350,000	152,000	505,000
Time To Finance	20 yrs.	30 yrs.	not given	20 yrs.	20 yrs.
Operating Costs/Car Mi	33.8¢	55.2¢	51.7¢	10.5¢	39.2¢
Debt Service/Car Mi	55.8	49.6	118.0	29.1	55.5
Total Cost/Car Mi	89.4	104.8	169.7	39.6	94.7
Oper. Cost/Pass Mi	1.1¢	1.8¢	1.5¢	0.5¢	1.7¢
Debt Service/Pass Mi	1.8	1.6	3.5	1.3	2.5
Total Costs/Pass Mi	2.9	3.4	5.0	1.8	4.2

1. Taken from San Francisco study
2. Includes cost of rolling stock except as noted
3. Does not include cost of rolling stock
4. An estimate for a suspended monorail system over the same route gave capital costs only slightly in excess of those shown here
5.Costs are based on Venezuelan prices and may not be directly comparable



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THE I-ROADS AND SAFETY

by Fred Backus CiE '69

THE National System of Interstate and Defense Highways, more commonly known as the Interstate System or the I-System, is a 41,000-mile network of modern freeways spanning the United States. The System, when completed in 1972, will comprise little more than one per cent of the nation's total road and street mileage, but will carry 25 per cent of all motor vehicle traffic. It will link 90 per cent of the country's cities of over 50,000 population, as well as thousands of smaller cities and towns, and will join the main International Highway Routes at our boundaries with Mexico and Canada.

The System was devised to move the large amount of traffic on the highways today and in the future as quickly, efficiently, and safely as possible. This report will discuss only the safety aspects of the Interstate System, first the good and the poor safety characteristics, and, secondly, the research being done on accidents on the I-System. The material will be precluded by a brief history of the Interstate System and followed by an outlook on the future of the System.

A BRIEF HISTORY OF THE INTERSTATE SYSTEM

The history of the I-System can be traced back to 1929, when a formal report was made to Congress on the feasibility of such a system. There had been other transcontinental networks dreamed of, but this was the first official proposal. Another study, this one in 1944, recommended a 40,000-mile superhighway network for the country. The Federal-Aid Highway Act of the same year called for a National System of Interstate Highways to be limited to 40,000 miles. The need for a quicker and safer transcontinental highway system that would by-pass large cities but still provide access to them had been recognized. By 1947, selection of the general locations of the main routes had been made, but it was not until 1955 that all exact locations were settled. Some additional mileage was allotted to the System when Hawaii became a state, but Alaska was not given any Interstate mileage and is the only non-participating state.

Like the location selection, the financing of the project was not worked out until the middle 1950's. The federal share was determined to be 90 per cent or $37 billion of the $41 billion. Then, with most of the locational and financial details decided upon, a bill was introduced in Congress in 1955. It was not until the next year that, as part of the Federal-Aid Highway Act of 1956, it became law.

Work began that year and was geared for simultaneous completion in every state by October, 1972. Progress in the states to date is varied. Some have as much as 70 per cent completed while others have only 30 per cent or less. At the present time, with just under five years remaining until the anticipated completion date, it seems likely that most all the work will be done on schedule.

Since the time that the first miles of the Interstate were opened, there has been very little doubt that the system is and will be very beneficial to the country. Driving time has been cut in many rural and urban areas. Crosstown trips that formerly took 30 minutes now take ten minutes or less. Billions of dollars are being saved yearly. Estimates for 1973 are $11 billion for that year alone. The economic growth of many cities and towns due to the I-System is equally substantial. However, the benefit that is perhaps the most rewarding is the safety benefit.

SAFETY CHARACTERISTICS OF THE INTERSTATE SYSTEM

There are certain features designed into the roads of the Interstate System that have made them much safer than other highways. Some of the major features are:

1. a median strip (often planted to divide the highway visually as well as physically)
2. shoulders free of obstructions
3. controlled areas
4. accelerating and decelerating lanes at interchanges for easy traffic flow
5. dual lanes
6. easy curvature and grades
7. long sight distances

The results of these improvements on our major traffic arteries have been very encouraging. A Bureau of Public Roads study showed that, based on rates per 100 million vehicle-miles of travel, freeways in urban areas showed a fatality rate of 2 compared with a rate of 4 for roads with no access control. A comparison was also made of fatality rates on parts of the Interstate open to urban traffic with older roads in the same traffic corridors that formerly carried most of the present Interstate traffic. On the older urban streets, the fatality rate per 100 million vehicle-miles was 5.1. With the opening of the nearby Interstate highways, the combined rate for the Interstate and the other roads studied dropped to 3.9 in urban areas. On the Interstate alone, the fatality rate was 2.6.

The I-System is also lowering accident and injury rates on nearby traffic corridors by helping to relieve congestion, according to the Automotive Safety Foundation. For urban areas of 50,000 or more population, the injury rate on the older streets studied was 207 per 100 million vehicle-miles and the accident rate was 1,386, prior to the nearby Interstate construction. After the Interstate Highways were opened to traffic, the injury rate dropped to 91 and the accident rate dropped to 294 in the corridor. These results are expected to improve as freeway users gain additional experience in handling their vehicles on these new facilities.

Many other figures of a similar nature could be cited. There is no doubt that the Interstate has been a definite safety benefit to the nation's highways. However, the I-System is not completely without features that tend to make it hazardous. Some of these dangerous features are:

1. poor road sign placement
2. poor guard rail placement
3. steep banking at road's edge

While most of these features are localized, the hazards cannot be overlooked. The large distinctive white-on-green road signs of the Interstate are often quite close to the shoulder of the road and are supported by large pipe-like material. Most of these supports are very strong and will not yield much if hit by a moving car. Also, on some of these signs, the supports have large concrete bases that are high enough to be hit easily by a car if it should go out of control. These large blocks would deliver a tremendous impact on the car and would almost certainly cause a fatal accident. Presently, however, these signs are being replaced by ones with break-away supports that would snap off if hit by an auto, and with bases buried beneath the ground.

Guard rails present a similar problem. Often near bridge abutments, there are guard rails to prevent driving into the ditch and thus into the bridge. However, in a few isolated cases, guard rails have been placed so a car hitting them would ride along the side and into a corridor of the underpass. This kind of accident would probably prove fatal, too. Therefore, these guard rails are being relocated to prevent serious accidents. Another problem with the guard rails ties in with still another problem — steep banks that end abruptly with an equally sharp bank heading back up forming a V-shaped ditch. If guard rails are not present and a car goes down the embankment, it will not stop slowly, but

Table 1. Fatal Accidents, Fatalities and Injuries on Completed Sections of the Interstate System July-December 1966, by Type of Accident

Type of Accident	Accidents			Number of Fatalities		Fatal Accidents Involving Non-Fatal Injuries		
	Number	Percent of				Number of Accidents	Injuries	
		Total	Subgroup	Total	Per Accident		Total	Per Accident
Total	993	100.0		1,231	1.24	537	1,212	2.3
Single-Vehicle	642	64.7	100.0	747	1.16	288	567	2.0
Ran off the Road	566	57.0	88.2	668	1.18	275	542	2.0
Pedestrians	63	6.4	9.8	64	1.02	5	5	1.0
Overturned on Road	7	0.7	1.1	8	1.14	4	7	1.7
Struck Object on Road	6	0.6	0.9	7	1.16	4	13	3.3
Multiple-Vehicle	351	35.3	100.0	484	1.38	259	645	2.6
Rear-end Collisions	214	21.5	61.0	256	1.20	149	345	2.3
Head-on Collisions	116	11.7	33.0	206	1.78	102	280	2.7
Wrong-way Drivers	36	3.6	31.0*	67	1.86	31	65	2.1
Vehicle from Opposing Lanes	70	7.1	63.3*	128	1.83	65	198	3.0
Other	10	1.0	8.7*	11	1.10	6	17	2.8
Sideswipes	14	1.4	4.0	15	1.07	7	18	2.6
Other	7	0.7	2.0	7	1.00	1	2	2.0

*These figures represent the percentage distribution of total head-on collisions.

rather suddenly when it reaches the bottom of the V. This serious kind of accident can be and is being prevented by placing guard rails at these locations.

Despite these few problems, the Interstate System has proven to be a much safer network of highways than any older system in the United States. All the safety features add up to an expected 8,000 lives a year saved by the time the Interstate is completed in 1972. This includes lives saved on the Interstate and on older highways relieved of traffic by the I-System.

ACCIDENT RESEARCH

Although the Interstate is a comparatively safe network of highways, there are naturally many accidents and fatalities on the System. The Bureau of Public Roads (BPR) is presently conducting two major studies of the Interstate accidents—the Interstate System Accident Research (ISAR), and the Fatal Accident Study. The former is divided into two distinct parts, Study I and Study II.

The Interstate System Accident Research Project Results of Study I

The objective of Study I will be to compare the accident rates for completed Interstate highways with nearby existing highways in the same transportation corridor. When the existing highway remains in operation after the Interstate is opened to traffic, data will be obtained for the existing highway both before and after the opening of the Interstate. A somewhat different procedure will be necessary if the Interstate replaces the old highway.

The most desirable method to study sections of the I-System will be by selection of control sections. These will be sections of highway not to be replaced by the Interstate and with similar characteristics to the existing highway before construction to Interstate standards. Data will be obtained for both the existing highway and control section before the Interstate has been opened. Similarly, data will be obtained for both the Interstate and control sections after the I-System is opened.

Study I, therefore, will obviously be quite useful in finding the effects of the safety characteristics that have been built into the Interstate System.

Results of Study II

The purpose of the Bureau of Public Roads Study II will be to compare various highway features of completed portions of the Interstate System with respect to their accident incidence and traffic characteristics in order to aid in refining geometric design standards and procedures to further reduce accidents on the Interstate System. The results will also be valuable in providing data for improving operations on the I-System.

The routes to be studied will be broken down into small study units, each homogeneous in all physical respects such as grade, type of lighting, shoulder material, and width, etc. Bridges, ramps, and other distinct features will be units by themselves.

When the data has been collected, it will be seen if there is a certain unit or group of units particularly well or poorly designed. This information would then be distributed to all the states so that they may each benefit from what has been learned.

According to the Bureau of Public Roads, much data has to be collected concerning each accident. Besides noting the exact location, every state should investigate these facts:

1. Amount of property damage, number of persons injured or killed —This will permit analysis of the severity of the accidents.
2. Hour of day of accident and light conditions — This will be of value for improving traffic operations, for evaluating highway lighting, and for other purposes.
3. Manner of collision and object hit—Certain types of collision may be expected to be associated with specific design features.
4. Vehicle classification and registration, and vehicle speed — These items will aid in improving traffic operation techniques. They will answer questions such as: a.) Are out-of-state drivers involved in a high proportion of accidents at interchanges, b.) Are trucks involved in more accidents on steep grades than on level stretches?

With this information, the Bureau of Public Roads should be able to come to rather definite conclusions about each unit. However, to date there has been only one report published and most of the results were inconsistent due to deficient basic accident data. With increased emphasis on obtaining accurate and complete accident data, the BPR should be able to come to some worthwhile and helpful conclusions.

RESULTS OF FATAL ACCIDENT STUDY

The second major Bureau of Public Roads study is the Fatal Accident Study. It is a report on 993 fatal accidents which occurred on completed sections of the Interstate during the last six months of 1966. The objectives of this project were:

1. To provide detailed information on the characteristics of fatal accidents on completed sections of this System
2. To gain some insight into the relative importance of the highway, the vehicle, and the driver
3. To evaluate the effectiveness of accidents reporting in this area.

The accidents studied were divided into two broad groups—those involving one vehicle and those involving two or more vehicles.

The largest category of accidents, 57 per cent of the total, were single vehicles running off the road. If the 70 head-on collisions which resulted from vehicles out of control from opposing lanes were added in, then the off-the-road total would be two-thirds of all accidents.

More than six per cent of the total were pedestrian accidents, which is surprisingly high for a limited access system. However, most of these pedestrians were persons who had left their vehicles for one reason or another.

Importance of Day of Occurrence

Saturday and Sunday each had about one-fifth of the accidents, Tuesday and Wednesday had the

(continued on page 31)

GREEN BAY AND
WESTERN R.R. CO.

Kewaunee, Green Bay &
Western Railroad

Employee's Time Table No. 87

Effective 12:01 A.M. Sun. April 18, 1965

C. G. REISINGER
Assistant Superintendent-Trans.

C. C. HALVORSON
General Manager

L. J. KNUTSON
Superintendent-Trans.

R.R.

RAILROADS of today are the backbone of the American transportation system. They transport the largest share of the basic commodities used in today's economy. Important commodities such as iron ore, coal, lumber, wheat, building materials, and new automobiles are transported more economically and more conveniently at a reasonable speed than by any other means of transport.

"Transportation contributes two kinds of utility to goods—place utility and time utility." Goods are of little value unless they are given utility, and transportation provides this by having goods where they are wanted. Railroads provide economical, dependable, and rapid movement of all goods. They also provide safe, comfortable, reasonably fast passenger and commuter service.

"It is no exaggeration to state that this country could not have attained its high degree of industrial prosperity without the railroads. Modern industry is geared to their speed, flexibility, and availability. Without railroads, the nation's prosperity could not continue."

Mass production of today would not be possible if it were not for rapid dependable transportation ex-expified by U.S. railroads. Most manufacturers carry inventories of parts and materials for two weeks or less and depend on a continuous delivery of parts and materials.

Railroads have made possible regional specialization of industry such as the auto industry. Electrical parts, car bodies, fender assemblies, enginers, and upholstery are each produced in different cities, then

YESTERDAY AND TOMORROW

by Dave Vannes, CiE '69

transported by rail to the assembly plant. The assembled cars are then loaded onto railway flat cars for distribution to potential markets.

Railroads are vital to the national defense of the nation. "We would not have been the victors in two World Wars had it not been for the railroads." More than 97 percent of all troops, 90 percent of all Army equipment and supplies, and 90 percent of all Navy supplies moved via rail during World War II. No other mode of transport had the capacity to handle the burden that was placed on the railroads. A total of 113,891 special troop trains were operated and 43,000,000 members of the armed forces were transported by railway. Railroads hold an equally important role in the transportation of war materials and supplies today.

ORGANIZATION OF RAILROADS

American railroads are organized on a departmental basis. Each department is responsible for a certain part of the total operation to make the railroad function smoothly as a unit.

The largest department of a railroad is the operating department. Railroads are divided into operating divisions or regions. To each of these divisions is assigned a superintendent and he is responsible for the operation and coordination of his division. The divisional superintendent is directly concerned with the operation of trains, yards, and stations. He may be aided in his duties by one or more Assistant Superintendents and Trainmasters. These officials are complemented by non-official supervisors. These include train dispatchers, yardmasters, train expediters, station masters, and train directors.

The traffic department, headed by a Vice-President of the railroad, is the sales department of the railroad. Its main function is the procurement of freight and passenger business. The department is divided into two sections, one dealing only with passenger business and the other only with freight business. Other matters handled by this department are the publication and distribution of tariffs and rate schedules, formulation of freight and passenger rates for submission to regulatory bodies, and the classification of freight through joint committees and bureaus with other railways. This department also tries to get new industries to locate on their line and to promote agricultural development. In recent years much emphasis has been placed on securing new sources of traffic and to lure traffic away from other modes of transport.

Advertising programs are carried on by the traffic department, most of it directed at freight shippers. A few railroads still actively solicit passengers to ride their trains, but most would rather eliminate all passenger service because of low revenues and high cost of operation. The few railroads that do seek passengers have succeeded in reversing the trend of having fewer and fewer rides on passenger trains.

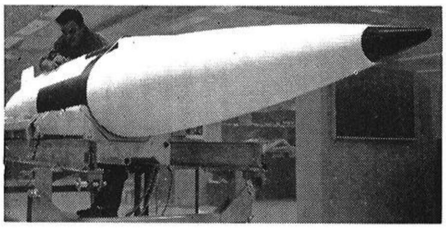
The engineering department is in charge of construction and reconstruction, and maintenance of tracks, bridges, trestles, shops, tunnels, store houses, signals, stations, and all other fixed property. Renewal, upkeep, and inspection of all fixed property is done by the engineering department. On some railroads the engineering department is completely independent, on others it and the mechanical department are part of the operating department.

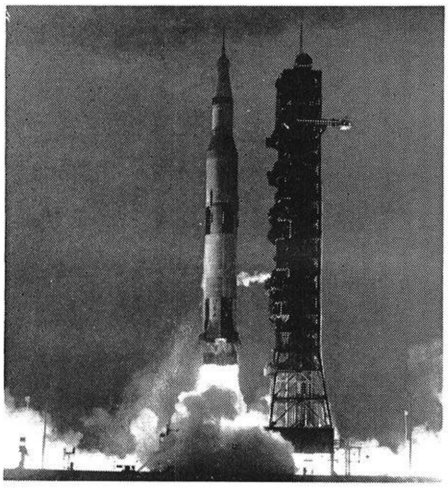
The Superintendent of Motive Power is the head of the mechanical department. The functions of his department are primarily the construction, repair, servicing, and inspection of locomotives and cars, work equipment, and marine equipment. This department operates locomotive and car shops, roundhouses, and portable equipment for making repairs at outlying points.

The legal department of a railroad is one of the more important departments. It is much larger than a legal department would be for an industrial corporation equal in size to a railroad. One reason for this is that the railroads do not carry liability insurance, but rather rely on the legal department to settle claims. It is usual practice to have attorneys for the railroad in every state in which the railroad operates. All matters handled before state and federal courts, state railroad commissions and legislative committees, drafting deeds, and signing contracts are all matters handled by the legal department. This department also handles personal injury claims and property damage claims against the railroad, and all tax matters.

The buying and selling of the materials used by a railroad is the main function of the purchasing and stores

(continued on page 23)

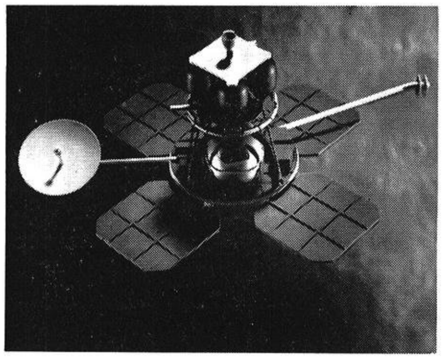


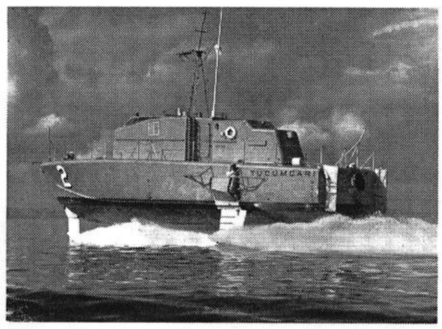


USAF SRAM. New U.S. Air Force short-range attack missile, now being designed and developed by Boeing, is a supersonic air-to-ground missile with nuclear capability. Boeing also will serve as system integration and test contractor.

NASA Apollo / Saturn V. America's moon rocket will carry three astronauts to the moon and return them to earth. Boeing builds 7.5 million-pound-thrust first stage booster, supports NASA in other phases of the program.

Boeing 747. New superjet (model shown above) is the largest airplane ever designed for commercial service. It will carry more than 350 passengers at faster speeds than today's jetliners, ushering in a new era in jet transportation.

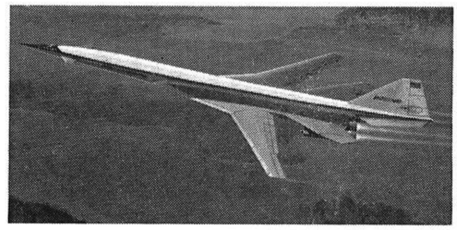


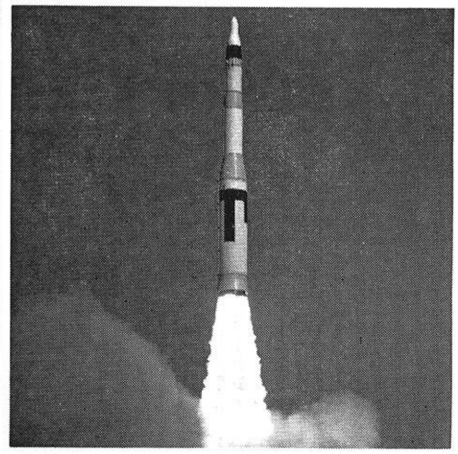


NASA Lunar Orbiter. Designed and built by Boeing, the Lunar Orbiter was the first U.S. spacecraft to orbit the moon, to photograph earth from the moon and to photograph the far side of the moon. All five Orbiter launches resulted in successful missions.

Boeing 737. Newest and smallest Boeing jetliner, the 737 is the world's most advanced short-range jet. It will cruise at 580 mph, and operate quietly and efficiently from close-in airports of smaller communities.

USN Hydrofoil Gunboat "Tucumcari". Designed and being built by Boeing, this seacraft will be first of its kind for U.S. Navy. Powered by water jet, it is capable of speeds in excess of 40 knots. Other features include drooped or anhedral foils, designed for high speed turns.





U.S. Supersonic Transport. Boeing has won the design competition for America's supersonic transport. The Boeing design features a variable-sweep wing, titanium structure and other new concepts and innovations.

CH-47C Chinook Helicopter. Boeing's newest U.S. Army helicopter is in flight test at Vertol Division near Philadelphia. Other Boeing/Vertol helicopters are serving with U.S. Army, Navy and Marine Corps.

USAF Minuteman II. Compact, quick-firing Minuteman missiles are stored in blast-resistant underground silos ready for launching. Boeing is weapon system integrator on Minuteman program.

Opportunity has many faces at Boeing.

Shown above are some of the challenging aerospace programs at Boeing that can provide you with a dynamic career growth environment.

You may begin your career in applied research, design, test, manufacturing, service or facilities engineering, or computer technology. You may become part of a Boeing program-in-being, or be assigned to a pioneering new project.

Further, if you desire an advanced degree and qualify, Boeing will help you financially with its Graduate Study Program at leading universities near company facilities.

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CONSTRUCTION AND OPERATION OF RAILROADS

Why construct a railroad? Railroads are constructed for many different reasons. Early transcontinental lines were designed to promote the settlement and develop the American West. Many other railroads in the U.S. have been built to reach raw materials such as iron ore, coal, copper, oil, or forest products while other have been built for carrying passengers. Those who built and operated the railroads did so to secure profit. They invested their money and expected a return for risking it.

Once it was decided to construct a railroad, a route location had to be chosen. After a complete field reconnaissance had been made and preliminary surveys had been run, a map was drawn to show approximate grade lines, alignment, and curvature. In deciding where to build the railroad, certain factors such as the terminals, important intermediate traffic centers, unique mountain grades, tunnel sites and major stream crossings are all considered in addition to the general topography of the land. When the alignment has been fixed, a location survey is run to transfer the paper location to the ground. One more survey, the construction survey, must be made before the next stage takes place.

American railroads have a considerable investment in land for right-of-way, and in buildings and bridges. About 131 million acres of land was granted to the railroads by the Federal Government. This land was worth about 94¢ per acre or a total of 123 million dollars. In return for the land, all U.S. railroads were required to carry federal supplies and troops at one-half the regular rate. At the time of the repeal of the Land Grant Act in 1946, a Congressional Committee found the railroads had paid over 900 million dollars for the land grants.

Through years of experience, the railroads have developed a very complete set of operating rules that provide for safe and dependable operation of trains. One method of operation is that of timetable-train orders. Trains run according to the schedules printed in the timetable. Extra trains, those not authorized by the timetable, run according to train orders. Any changes that must be made in the timetable because of delayed trains are done with train orders.

A newer system of train control is that of CTC, Centralized Traffic Control. With this system, a train dispatcher in his office can control the movement of trains over an entire operating division by operating track signals and switches. He can observe the progress of trains by a system of indicator lights on a control panel in his office. CTC permits a reduction in the number of main tracks needed to operate the same number of trains under the timetables-train order method.

The individual passenger or freight car is the basic unit of a train. Empty freight cars are placed at an industry for loading, and once loaded, are picked up by a switch engine and brought to a classification yard. Here cars are sorted and arranged according to destinations, then they are assembled into a train along with a locomotive and a caboose. The train then moves over the railroad in charge of the conductor. The conductor is held responsible for the proper operation of the train in accordance to the operating rules of the railroad. As a train moves over a division an accurate record is kept of all cars handled, those picked up and those set out. Many railroads now equip locomotive, cars, and stations with radios permitting train crews to stay in constant contact with wayside stations and to communicate between engine and caboose. When the train arrives at its final destination, the locomotive and caboose are removed, and the cars are reclassified, some for loading, others for unloading. Other cars will continue on to their final destination via the same or a different railroad.

RAILROADS VS. RIVAL TRANSPORTATION

Railroads compete not only with each other but many other modes of transportation. In recent years this intermodal competition has become very keen and railroads have made many changes in an effort to gain a greater share of traffic to be transported.

Each mode of transportation may be compared on these bases: flexibility, speed, dependability, safety, net tons per vehicle hour, horsepower per net ton, capacity, and total gross ton miles. Each of the factors shall be considered below.

Railroads are very flexible, they can haul small and very large shipments, up to 50,000 tons per train. They provide short and long haul passenger service, along with commuter service. A train may have a few or many cars, depending on the traffic to be moved. Railroads have the following advantages: a system of standard gauge tracks, four-feet eight and one-half inches between the rails, thus allowing interchange of cars between all railroads; standard equipment allows cars not on their own rails to be repaired by another railroad; a system of car interchange and accounting as required by the Interstate Commerce Commission; varied types of cars to transport all types of commodities. Basically the same facilities are needed for the operation of one or many trains. Railroad cars are built so that they are not worn out by the time they have outlived their useful economic life, thus railroads continue to use such cars until they are worn out.

Motor vehicle transport is more flexible for short hauls and for pick up and delivery of traffic to any shipper's door. The private automobile is the most convenient and flexible form of transportation of passengers. Highway buses are similar to the auto in flexibility, except they are not as comfortable for long distance travel. More passengers are now carried by private auto than by any other form of transportation.

Airlines are also single unit carri-

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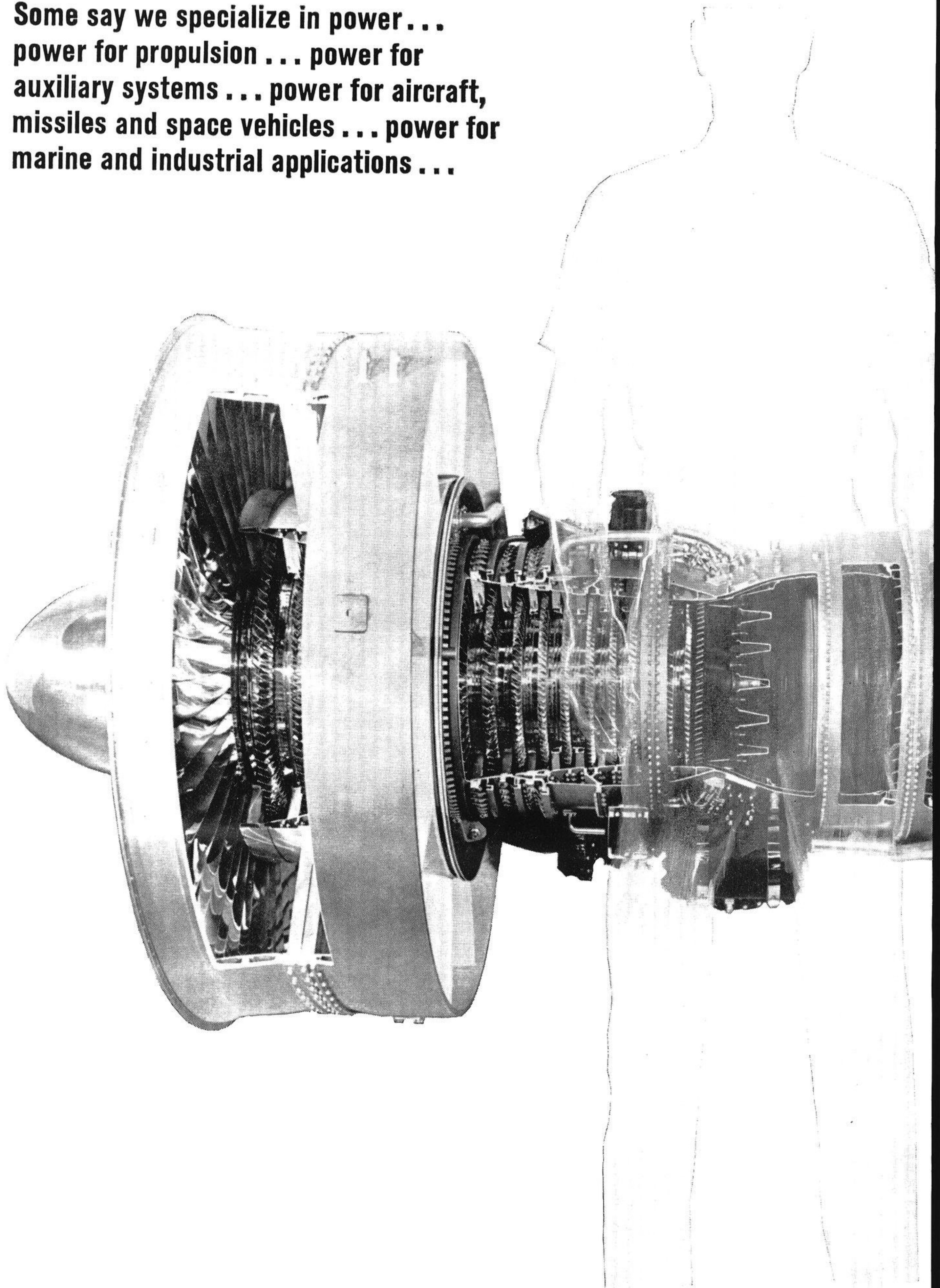
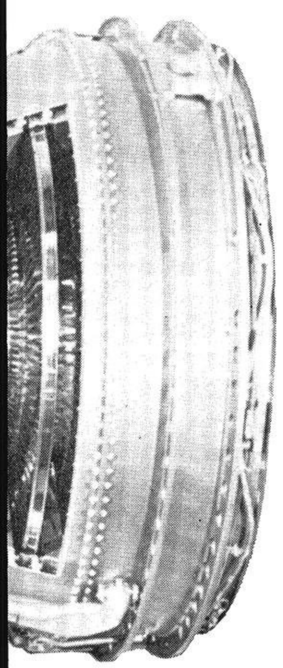
Some say we specialize in power . . . power for propulsion . . . power for auxiliary systems . . . power for aircraft, missiles and space vehicles . . . power for marine and industrial applications . . .





ers and have a payload of only a few tons at present. Airlines offer the fastest available transportation of freight and passengers.

A pipeline is a continuous flow mode of transport and it is the most dependable, but the least flexible. The traffic that can be handled is very limited and parts of a shipment cannot be removed or added except at a few certain stations. If there is a failure in a pipeline, the entire system is out of operation.

Passenger travel by train is fairly rapid, ranging from 75 to 150 miles per hour for mainline operation and 40 to 60 miles per hour for branchline operation. Freight trains operate at 50 to 70 miles per hour on the mainline and 20 to 40 miles per hour for local freights that do switching enroute.

The safest method of transporting passengers is by train. Travel by private automobile is the most dangerous. Travel on airplanes is almost as safe as by railroad, while buses are only about one-half as safe as trains.

A comparative measure of transport productivity is (net tons) times (the speed in miles per hour). A comparison of the various modes of transportation is shown below:

CARRIER	NET TON-MILES PER HOUR	QUANTITY
Railroads	Per Train Hour	25,000-50,000
Trucks	Per Truck Hour	260-2,400
Ships—Great Lakes	Per Ship Hour	100,000-300,000
Ships—Deep-water	Per Ship Hour	100,000-1,000,000
Towboats	Per Towboat Hour	100,000-270,000
Airplanes—Prop	Per Airplane Hour	4,500-7,500
Airplanes—Jet	Per Airplane Hour	8,000-10,600
Pipelines	Per Pumping Station Hour	1,000-37,100

Barge traffic has the ability to transport one or several barges in a tow, setting out and picking up barges enroute. Because of the lack of route locations available, barge traffic is limited. Great Lakes bulk carriers are rather inflexible because they must operate as a single unit carrier whether or not the boat is fully loaded.

The above values show the advantages that the railroads have. The average value of net ton-miles per train hour has been increasing each year.

During the year 1957 intercity railroads carried a total of 1902 billion ton-miles while all other carriers combined carried only 1087 billion ton-miles. This clearly indicates that trains have been and are successful in using their technological advantages to secure the largest share of intercity freight.

A factor used to determine the capacity is horsepower per net ton of payload. Typical values are listed in the table below:

CARRIER	HP/NET TON	HP/PASSENGER	AVERAGE
Railroads—Freight	3.15-1.00		2.64
Railroads—Passenger		31.5-5.0	5.00
Highway Trucks	11.33-2.13		7.00
Automobiles		60.0-6.0	15.00
River Tows	0.20-0.14		0.18
Cargo Ships	0.35-0.22		0.25
Airplanes—Freight	667-240		500
Airplanes—Passenger		230-140	160
Pipelines	2.00-3.00		2.50

FUTURE OUTLOOK FOR AMERICAN RAILROADS

At one time it could be said that transportation in the U.S. meant transportation by rail. This is no longer true. Railroads were the sole methods of transporting almost all overland freight and passengers. In the late 1920's and early 1930's motor carriers began to operate and they succeeded in taking business away from the railroads. The railroad companies were not alarmed because of the large amount of business they still carried. Similarly, the airplane came into general use and took many passengers away from the trains. Both of these competing modes of transportation continued to take business away from the railroads until recent years. The trend still continues with passengers, but it has been reversed regarding shipment of freight.

New programs such as TOFC, Trailer on Flat Car, have been very successful in luring freight back to the railroads. This system allows both highway and railway to utilize the most favorable aspects of each system. Another area that will bring more business to the railroads is that of containerization. Containers are loaded at the shipper's door, picked up by truck and hauled to the rail terminal where it is placed on a flat car. It is then hauled in a train to the destination and unloaded; never once during the movement was it necessary to transload the cargo from the container.

Railroads will also be called upon to solve problem of mass rapid transit in urban areas. A two-track railway line has a capacity equal to that of an 18-lane freeway, yet it occupies but a fraction of the area of a freeway and costs much less.

Research will hold the key to the future for the railroads. New methods of handling goods and people will be developed to enable the railroads to continue to prosper. The future does indeed appear bright for the American railroads.

"What I like about IBM is the autonomy. I run my department pretty much as though it were my own business."

"Tell some people you work for a big company, and right away they picture rows of gray steel desks with everybody wearing identical neckties.

"Well, that's the stereotype. When you look at the reality, things are a lot different. (This is Gene Hodge, B.S.E.E., an IBM Manager in Development Engineering.)

"IBM has over 300 locations. They believe in decentralization, and they delegate the authority to go with it. To me, it's more like a lot of little companies than one big one.

"Take my own situation, for example. I act as a kind of entrepreneur for my department. I decide if we should bid on certain government contracts for my group and then develop the proposal strategy. Of course, upper management reviews my decisions, but to a great extent I run my own show.

"Another thing that makes this like a small company is the close relationship with your boss. You're almost always hired by the manager you're going to report to. And you work for him on your own or in a small team. It's part of his job to know your long term goals and help you reach them.

"This same interest in the individual also shows up in IBM's educational programs. I'm getting my Master's now, and IBM's paying the entire cost, and some of the class time is on company time."

Gene's comments cover only a small part of the IBM story. For more facts, visit your campus placement office. Or send an outline of your career interests and educational background to I. C. Pfeifer, IBM Corp., Dept. E, 100 S. Wacker Dr., Chicago, Illinois 60606. We're an equal opportunity employer.

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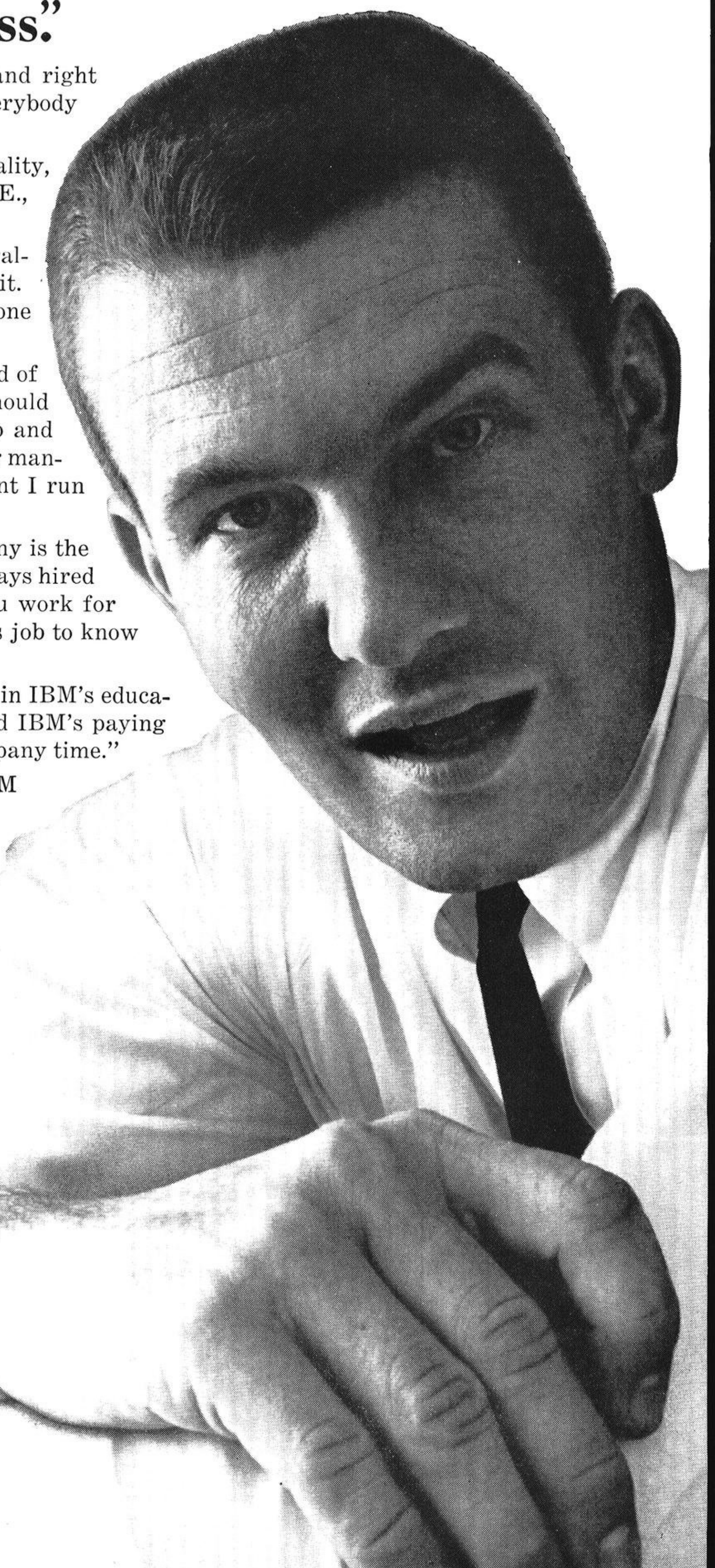


rapid changes in track level to be made at stations which are required at ground level and where obstacles have to be cleared.

Alweg Monorail

The Alweg monorail is a supported transit system and is used quite extensively in the U. S. For instance, Alweg monorails have been constructed at Disneyland, Seattle, San Francisco and other heavily populated cities.

The Alweg boasts the same advantages over the conventional railroad as does the Safege suspended system: It has absolute protection against derailment and provides a quiet, smooth ride. Its overhead structure is simple and compact. One advantage the Alweg has over the Safege is that it claims better dynamic behavior as a result of a high center of gravity and positive guidance by rail beams. Sidesway is almost nonexistent in the supported Alweg. Not so in the case of the suspended monorail which has to be dampened to provide passenger comfort. Also, the cost promises to be lower for a supported system since columns would not have to be as high for vertical clearance from the ground.

Passengers are located above the beam, and the lower portion of the lightweight car, which drapes over and encloses the beam, provides sound-proofing. This effectively insulates the motor compartments and wheel casings. The power drive is provided by electricity through 600 volt D. C. motors which receive current through collectors and from a live rail running along the beam track.

The Alweg system has become the most accepted system among the two types of monorails. This can be attributed to the safe guidance principle it utilizes which was introduced by Alex Wennergren in 1952. Through development and thorough testing of this system and its guidance mechanism, the Alweg is claimed to provide fast, safe and efficient means of handling rapid urban transportation.

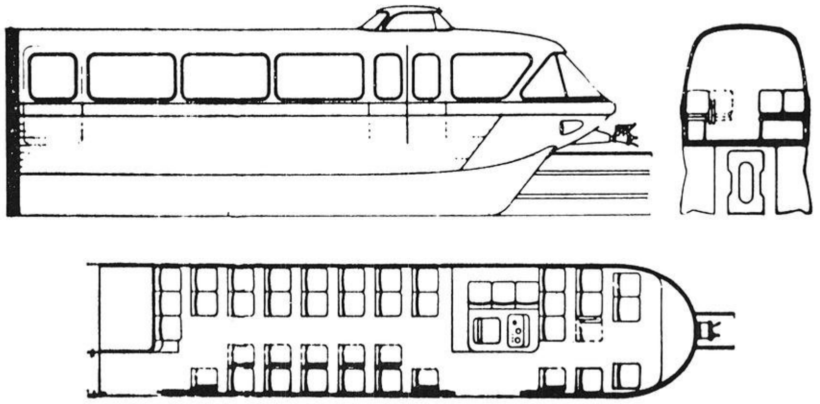
The Westinghouse Transit Expressway

The Westinghouse Transit system is similar to the supported monorail in track structure, but the cars are characteristic of the conventional bus. It is guided by a central "I" beam located between the two running, concrete beams.

The Westinghouse system is unique in that it is the first fully automatic rapid transit system. It is completely controlled by a digital computer in conjunction with a series of wayside controllers. The central computer establishes schedules, and supervises the system's performance. The wayside controllers regulate speeds, start and stop trains, open and close doors, and monitor train operation.

To provide economic, frequent, and flexible round-the-clock operation, the vehicles are relatively small and lightweight. They seat 28 people and, when necessary, can accommodate 70 including standees. The vehicle's suspension system, air conditioning unit, and large tinted windows create a comfortable atmosphere never before associated with transit riding.

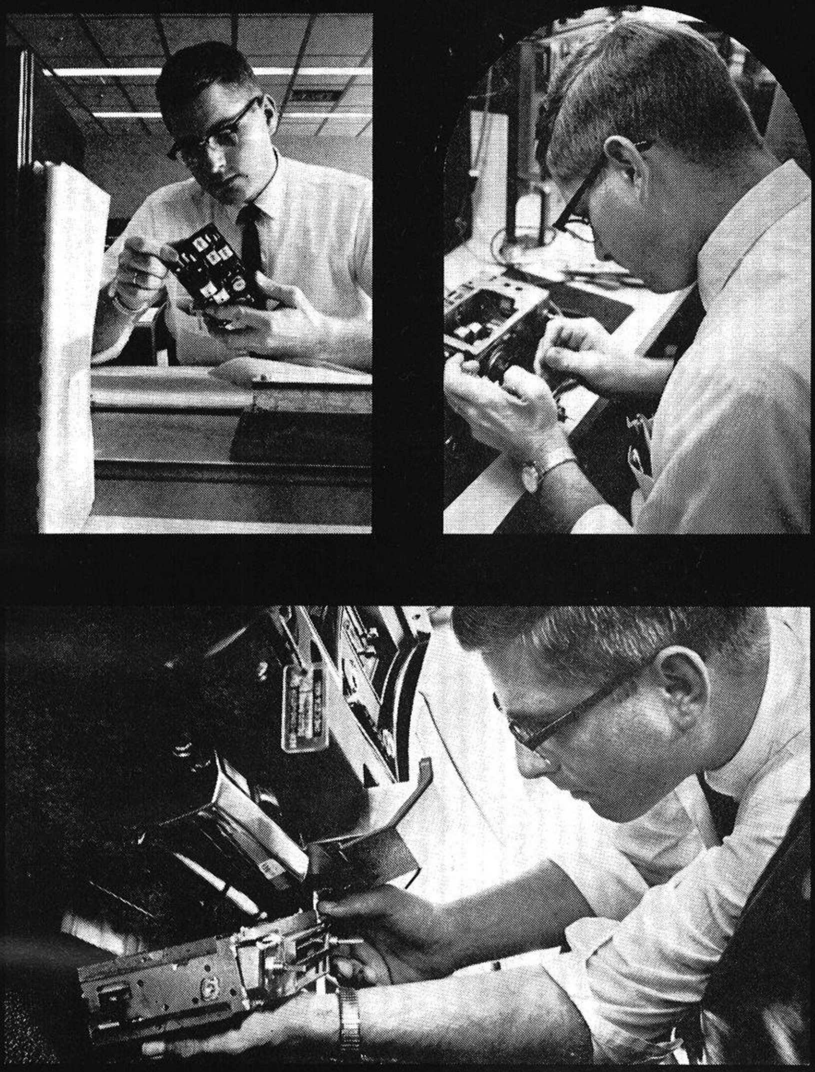
It is apparent that many cities are threatened with an ever-increasing problem. Continual construction of freeways is not the best answer to the problem. In the future the whole concept of moving people in metropolitan areas will be changed. Rapid transit by monorail offers an acceptable solution to the problem of traffic congestion.



The Alweg supported monorail.

COMPARISON OF THE THREE RAPID TRANSIT SYSTEMS

	Alweg	*Safege*	*Westinghouse*
Type	supported	suspended	supported
Length	60 ft	59 ft	30.5 ft
Width	10 ft	8 ft	102 in
Height	10 ft	10 ft	10 ft
Internal Height	7 ft	7 ft	7 ft
Number of Seats	64	48	28
Seating Capacity	100	75	28
	225 (standing)	150 (standing)	70 (standing)
Car Weight	23 tons	23 tons	10 tons
Motor	600 V D.C.	600 V D.C.	565 V D.C.
Deceleration	3.4 ft/sec^2	3.2 ft/sec^2	3.5 ft/sec^2
Acceleration	2.7 ft/sec^2	2.5 ft/sec^2	2.5 ft/sec^2
Economical Speed	50 mph	45 mph	50 mph
Beam Span	160 ft	104 ft	103 ft
Distance Between Axles	20 ft	20 ft	—



lowest totals while Monday, Thursday and Friday had a slightly higher percentage.

Importance of Accident Environment

As might be expected, 44 per cent of the accidents took place during daylight hours, 52 per cent at night, and 4 per cent at dusk or dawn. Less than one-fifth of the night accidents occurred on a lighted section of highway.

Four-fifths of the accidents occurred during clear or cloudy weather on dry pavement. An exception to this was head-on collisions, two-fifths of which occurred during inclement weather.

Straight sections of the highway constituted 80 per cent of the total accidents, two-thirds of them on level roads. Single vehicle accidents, however, occurred somewhat less frequently on straight sections — 73 per cent of the total.

Importance of the Vehicle

Passenger vehicles accounted for 79 per cent of the total accidents. This corresponds to the ratio of total number of passenger vehicles to total number of vehicles. However, passenger vehicles were somewhat over-represented in single vehicles off-the-road, and head-on collisions. Rear-end accidents, on the other hand, primarily involved property-carrying vehicles.

Police investigations showed that the age and condition of vehicles had little bearing on fatal accidents. Two-thirds of the cars were less than five years old and 56 per cent had no apparent defects.

Importance of the Driver

One-third of the drivers involved in the total accidents were under 25 years of age. Approximately 20 per cent of all licensed drivers are under 25. Therefore, this age group was substantially over-represented.

Slightly less than 16 per cent of the drivers were female who therefore were under-represented by comparison with the total driving population which is estimated to be approximately 40 per cent women.

Driver condition was found to be a fairly important factor, with 90 per cent of the conditions involving sleep or drinking. The former was much more frequent in off-the-road accidents (57 per cent as compared with 36 per cent for drinking). In head-on collisions, however, drinking was of primary importance with 83 per cent of the drivers' defects involving alcohol.

Driver violations were found to be involved in 70 per cent of the cases. Of these, 45 per cent indicated excessive speed and 18 per cent reckless driving.

The Fatal Accident Study has, therefore, proven to be very useful in examining accidents where deaths occur. By making use of this study, the Bureau of Public Roads will be able to determine the major factors involved in fatal accidents and will hopefully be able to reduce the number of deaths.

THE FUTURE OF THE INTERSTATE SYSTEM

At the present time, the future of the system looks good. With all sections of the Interstate due to be completed in five years, our highway needs look like they will be satisfied for a while. However, the Bureau of Public Roads will have to have a vigorous maintenance program to keep the System in good working condition. Soon, though, as more and more vehicles appear on our roads, the Interstate will become inadequate, too. There are various plans and ideas for a super highway system of the future, or an expanded Interstate System. These ideas are all in the distant future, though, and the future of the United States' highway system after 1972 can only be speculated upon.

Table 3 Fatal Accidents on Completed Sections of the Interstate System, July-December 1966 by Weather Conditions

Type of Accident	Total		Clear or Cloudy		Rain		Snow or Sleet		Fog		Not Reported*
	No.	P.C.	No.	P.C.	No.	P.C.	No.	P.C.	No.	P.C.	Number
Total	993	100	811	83	124	12	18	2	27	3	13
Single Vehicle	642	100	535	85	77	12	9	1	13	2	8
Ran off the Road	566	100	466	84	75	13	6	1	12	2	7
Pedestrian	63	100	58	93	1	2	2	3	1	2	1
Overturned on the Road	7	100	6	83	1	17	-	-	-	-	-
Other	6	100	5	83	-	-	1	17	-	-	-
Multiple-Vehicle	351	100	276	80	47	14	9	2	14	4	5
Rear-end Collisions	214	100	176	83	16	8	8	4	11	5	3
Head-on Collisions	116	100	79	69	31	27	1	1	3	3	2
Wrong-way Drivers	36	100	33	92	2	6	-	-	1	2	-
Vehicle from Opposing Lanes	70	100	38	56	28	42	1	1	1	1	2
Other	10	100	8	80	1	10	-	-	1	10	-
Sideswipes	14	100	14	100	-	-	-	-	-	-	-
Other	7	100	7	100	-	-	-	-	-	-	-

* Cases not reported excluded from percentage distributions.

FEEDBACK

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ticularly for new TAs. We feel that such programs should cover not only specific expectations made of TAs, but also general pedagogical matters related to effective teaching.

The committee also recommends *on-going departmental programs on teaching led by faculty members recognized for their teaching excellence. Participation in such programs should be recognized as a significant part of the teaching load for the faculty members, and where feasible rewarded by course credit for the students.*

In this same spirit, we recommend that *conferences between the TAs and the specific staff member in charge of each course be regularized and enriched.* This is a proposal that wins a great deal of support from both students and faculty, but actual implementation has fallen short of the ideal. Some 40% of the TAs report that such conferences occur either never or less than once a month. Moreover when the conferences do occur, they tend to be restricted either to busy work or to such routinized matters as making up exams and setting curves; that is, there are few excursions into deeper pedagogical forests. Part of the problem here may be that faculty members feel there is little to talk about or that educational abstractions are not worthy of the time. But one stimulus to productive conferences is faculty visitation of their TAs in actual teaching situations. Less than a third of our TA respondents reported that they had been visited in discussion or lab sections by the professor in charge, although 57% of our faculty respondents indicate that they have visited TA sections in the past. Certainly the committee recommends that *"faculty visitation" be extended. Moreover, we would go on to suggest that new TAs might benefit from exchanging visits with more experienced TAs.*

For our purposes, it seems unreasonable to expect the faculty to go out of its way in helping TAs without some form of reward or compensation. Therefore, the committee recommends *that additional teaching credit, i.e., teaching load reduction, be provided for those faculty members who must supervise TAs, and on a scale depending upon the number of TAs involved.* This would be done with the clear understanding that the present interaction between most professors and their TAs would increase in both qualtity and quality.

Finally, there is the problem of evaluating TAs.

The three most common sources of information by which professors judge their TAs are informal feedback from students in the course (73%), more or less intuitive impressions base upon TA's out-of-class intellectual performance (68%), and the previously mentioned visitation (57%). Some 15% use systematic questionnaires of students in the course, while 13% require weekly reports on what actually happened in class, and only 5% require weekly study plans or their equivalent. Still, the committee recommends that *each department reconsider and clarify both its techniques and criteria of evaluation. Without urging spurious systematics, we feel that faculty members should sharpen their assessments and communicate them more often to the TAs themselves.*

No matter what the TA role, most respondents to the TA survey were agreed in their desire for more freedom, responsibility and intellectual creativity. As mentioned earlier, this general area was tied for first place when we asked the TAs to give us their own opinions of needed improvements. While it was an expected result, it takes on more significance in light of the disquieting finding than 62% indicated that they had not been encouraged to use "innovative or experimental techniques."

To this end, we also *encourage departments to allow TAs to express their preference for course and section assignments and to accommodate these wherever possible.*

Another concern is the amount of time required for meeting the TA's responsibilities. Therefore it is recommended that *these work loads be re-evaluated and, as a long range goal, that they be reduced to a level where the TA can provide the highest quality instruction, with sufficient time for preparation, orientation programs, and student contact.* However, two steps can be taken immediately. First, *we recommend that any TA who teaches in two or more courses with different preparations be appropriately compensated.* Secondly, *we recommend that many of the non-teaching tasks of the TAs could be effectively handled by secretarial or student help.* This might include a good deal of the routine bookkeeping plus some of the aid that many TAs provide on the side to their professors in lecture preparations, etc.

Finally, where the TA is expected to work closely with students it is only reasonable to assure that he is provided the facilities and space in which to do so. Therefore, the committee *recommends that teaching consultations have increased priority for office space.* It is significant that TAs themselves rate better office space high among possible improvements in the current situation. Some headway has already been made in this area, but too many TAs are still working under impossibly crowded conditions.

The teaching assistant is, of course, a temporary appointment, and until it becomes possible to develop the more desirable forms of funding that we have recom-

(continued on next page)

→ FEEDBACK ←

mended in the first section, most TA appointments will be for one year, or sometimes only for one semester. Thus, future opportunities for funding become exceedingly important to TAs, and we also recommend that *departments develop clearly defined procedures for reappointment.*

It is recommended that *each department set up a Graduate Student-Faculty Committee, with equal numbers of faculty and elected students including proportional TA representation.* This committee would act as an information center, a source of recommendation, and a grievance appeal board.

One further specific task of such *committees would involve responsibility for publishing and distributing a set of departmental procedures.* Specifically with reference to TAs, it should provide up-to-date information on virtually all of the topics this report discusses, including (a) criteria used in selecting new TAs, such as estimates of the applicant's potential as a teacher, academic records, letters of recommendation; (b) procedures used in evaluating TA performance; (c) criteria used in reappointing TAs as discussed above; (d) salary scales, pay in relation to work load, etc.; (e) additional duties and responsibilities; (f) dates of orientation programs; and (g) the nature of the Graduate Student-Faculty Committee itself.

This committee has already implemented a solution to this aspect of communication with the TAs, by publishing the first edition of the *TA Handbook* for use beginning in the Fall semester, 1967. Naturally, it is recommended that *publication of the TA Handbook be continued, and that it will be revised regularly.*

FEEDBACK, 1925

A RECENT attempt was made by Dean Turneaure to determine the opinions of alumni regarding the engineering curriculum. Questionnaires were sent to alumni who have been out for several years, and the replies were treated confidentially. The committee has not yet reached definite conclusions which can be published, but some statements made in letters accompanying the returned questionnaires were pertinent and may prove of interest to readers of THE WISCONSIN ENGINEER.

An alumnus, who is now in patent-law work writes, "In general, I think my engineering training was very valuable and quite satisfactory, but there are certain points in which I think it was deficient. In particular, too much emphasis was placed on technical training intended to place the student in a position to be of some use to his employer immediately after graduation. I doubt whether many graduates of engineering schools are of much value immediately after graduation even when they have had extended training in technical work such as drafting, designing, laboratory work and the like, and I believe that the time in college would be much better spent if many of these purely technical courses were eliminated and others reduced in scope so that more time could be devoted to courses which are purely cultural in character. In my opinion, the purpose of an engineering education should be to give the student a broad cultural background as well as a general knowledge of engineering industry, and the effort to make the engineering school a trade school should be carefully avoided. It is time enough for the student to learn the details of a particular job after he has graduated, and my observation leads me to believe that it is necessary for him to do this anyway, even where he has had extensive training in purely technical courses in an engineering school.

"Moreover I am convinced that a large proportion of the graduates of engineering schools do not follow the profession of engineering, in a technical sense, after graduation. Their duties are usually along the line of business management, salesmanship, and so forth, for which the technical engineering course gives no training. I think it would be well to abolish, for undergraduates, all distinctions between the engineering courses as now organized, and give one course in general engineering, including in that course a generous allotment of courses in English, Economics, Logic, Political Science, Public Speaking, Money and Banking, and so forth, thereby producing a broader and more cultured graduate who could then, if he wishes to, specialize in one of the several branches of engineering.

"Another way in which the engineering training might be improved is the giving of more advice and general information to engineering students, particularly when they are freshmen. Most freshman students in engineering schools do not know why they are there. They have taken up the study of engineering merely because they have been advised to do so by their parents, or their school teachers, or others who are not in a position to advise them correctly. It naturally follows that many of them are misfits and, if not dropped because of low scholarship, they often do not find it out until they graduate. The test of scholarship is not the only one of fitness for the engineering profession. I suggest that on organized effort be made by the engineering faculty to give to all freshmen, as soon as they enter the school, advice and instruction concerning the nature, purposes, and ideals of the engineering profession, as well as information concerning the kind of work the graduate may expect to do when he leaves school, thereby exciting the ambition of those who have a taste for engineering and disillusioning those who have not.

"An engineer's stock in trade is ideas. He must sell these ideas before he can put them into practice. An idea poorly expressed and unconvincingly offered is not readily marketed. The student must be made to realize that in the field he deals with modern businessmen who cannot be classed as 'Rough Necks.' His written reports must be in good English, concise, and to the point. His oral reports must be delivered convincingly and unfalteringly in good English.

"Industry has found in recent years that the fundamental training of the engineer has fitted him admirably

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WHOSE PRINCIPLES? editorial continued from page 7

and everything associated with it as the Establishment. There should be no giving in once the rules have been established. There are orderly ways to change rules, and if these people are not willing to operate in an orderly way, then they can leave this academic community of their own free will, or be assisted. We urge you who are in a position to speak to do so; fight for the preservation of free speech and the right to demonstrate as hard as you can, within the bounds of the laws set down by the academic community. Above all, we urge you to keep the engineering placement office as an integral part of engineering education.

Mary E. Ingeman
Editor, *The Wisconsin Engineer*
Vice-President ASME
General Exhibits Chairman,
1969 Engineering Exposition

FEEDBACK, 1925

for executive work. His broad knowledge of the natural and physical laws and their application and the keen faculty of analysis which he has aquired through his college work is of great value to industry in directing men. However, unless he can transform his technical phraseology into the parlance of dollars and cents of the business world, this field is closed to him."

Views on some subjects are very diversified. The committee in charge of the work is attempting to summarize the replies, and will undoubtedly reach some definite conclusions in the near future.

Does this sound familiar?

NEW I.E. SOCIETY

The University of Wisconsin has a new student organization for engineers — Industrial Engineers, that is. Newly former is the American Institute of Industrial Engineers-University of Wisconsin Student Club. This is the first club formed in Wisconsin, and is open to all engineers, undergraduates or graduates, enrolled in the new Industrial Engineering curriculum or completing the Mechanical Engineering degree with the industrial engineering option.

The AIIE Student Club plans to have monthly meetings with guest speakers, films, and perhaps field trips. Besides the various activities planned, membership in the AIIE brings the monthly *Journal of Industrial Engineering.*

The Student Club is affiliated with the national organization of American Institute of Industrial Engineers which was founded in 1948 by Wyllys G. Stanton, a professor at Ohio State University. In the short 20 years AIIE has grown to 160 Chapters with 15,000 members.

For more information any one of the following officers will be glad to answer any questions: President, James Garman; Vice-President, Robert Ludke; Secretary, James Kahler; Treasurer, Dennis Kaetterhenry; Advisor, Prof. George Huber.

wisconsin's finest

Terri Moore

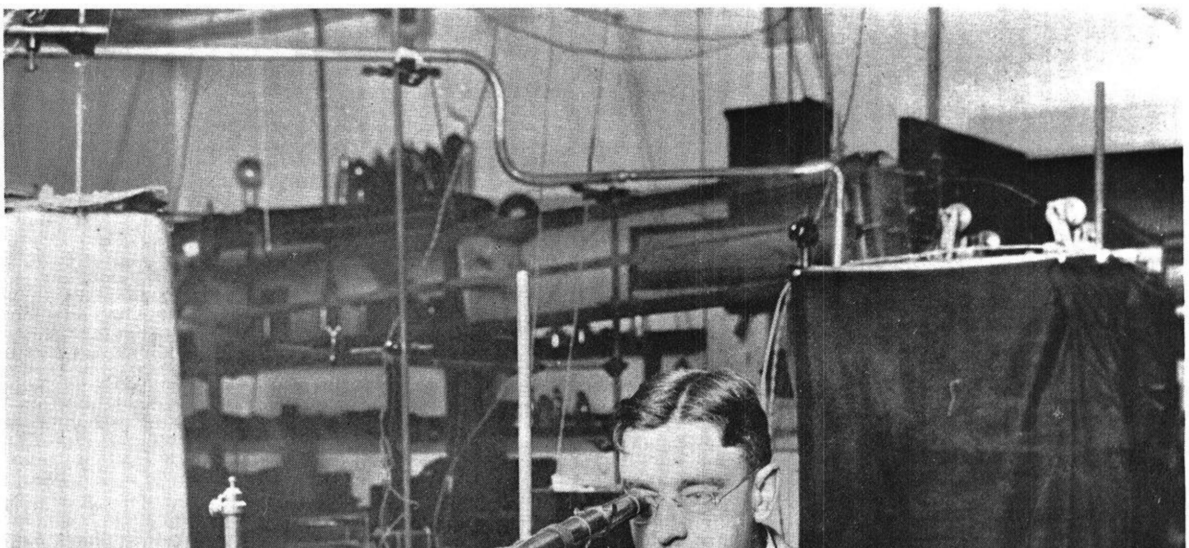
For March, THE WISCONSIN ENGINEER presents a bouncy, 5′ 3″ blond from Richland Center who loves science-fiction books, romantic movies and fun parties. Since Terri is a junior majoring in English, you may wonder where she was when you were struggling through freshman English. Right?

photos by Norm Frater

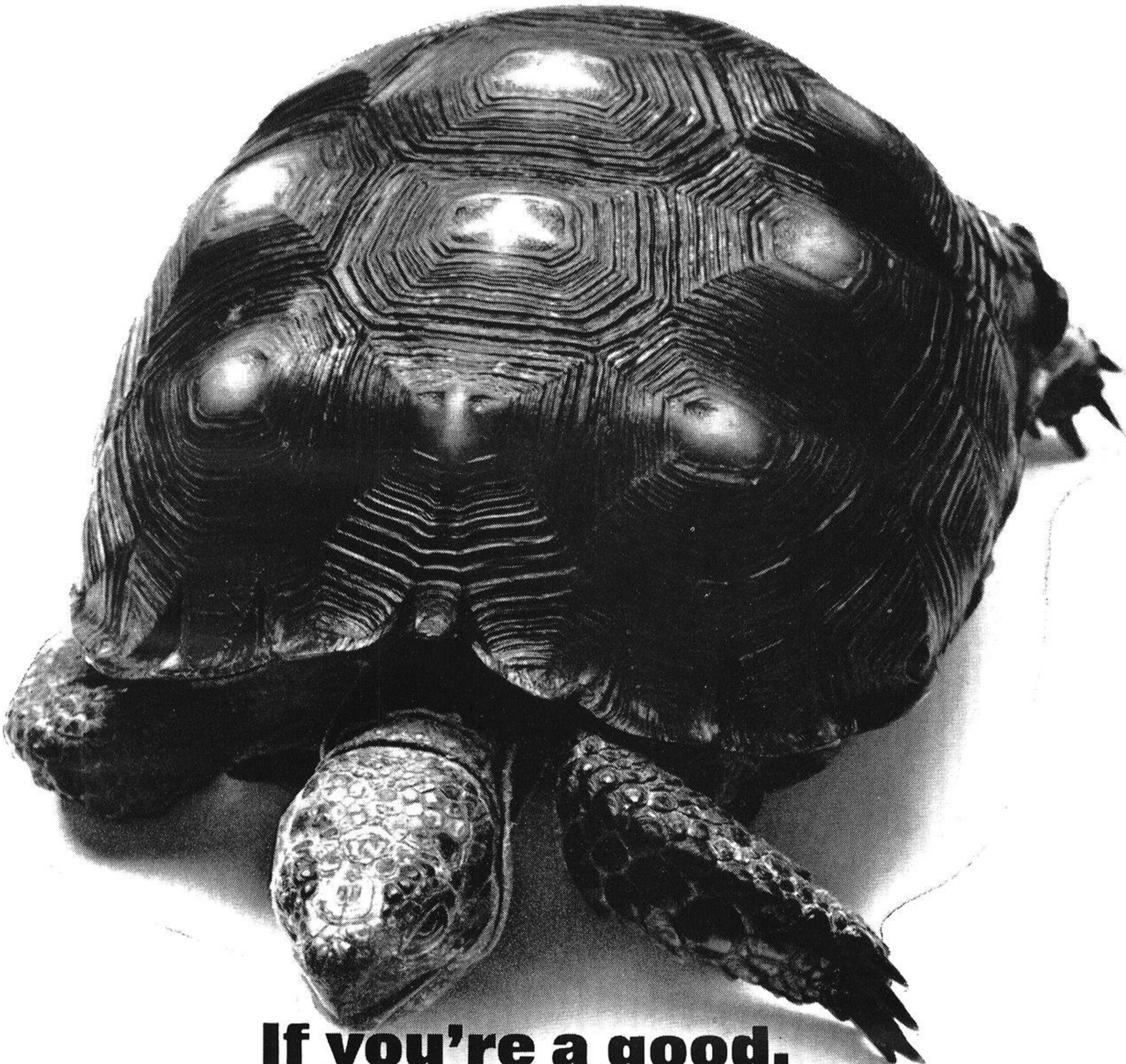
Terri likes to skate and toboggan and dance. She loves dogs and pizza and beer, and has always wanted to live in Colorado. We don't know if all blonds have more fun, but we do have more fun with blonds—at least with Terri.

PICTORIAL

wisconsin's album



Radio in 1924. WISM hasn't changed much.



FILEABLES

The apple in every man's eye is the peach with the best pear.

* * *

Once upon a time there was a greedy Baron, who lived in a far off land. He was one of the richest men in the land, second only to the King, who had a beautiful daughter. So the Baron decided to ask the King for his danghter's hand in marriage. The King said, "Yes, but under the condition that you get me six golden apples off the golden apple tree." This tree had a notorious reputation. Every time someone would pick an apple off the tree a big yellow hand would come down and squish him before he could get away.

The Baron went up to his squire and asked him if he would go get the six apples. The squire agreed. The next day the squire went to the tree and picked the apples, but as he left, the big yellow hand came down and squished him.

The Baron, hearing of his squire's failure, went to his page and asked him to get the apples. The page had also heard of the squire's fate and refused. The Baron pleaded with him and offered him a rich reward, so the page finally agreed and set out to get the six golden apples.

The page sneaked up on the golden apple tree and quickly grabbed six of the golden apples. As he began to run away, he saw the big golden hand come down. He side-stepped and slipped out between the hand's fingers.

Moral of the story:

Let your page do the walking through the yellow fingers!

An M.E. was very indignant at being arrested. He staggered into the police station and before the captain had the opportunity to say anything he pounded his fist on the desk and said, "What I wanna know is why I've been arrested."

"You were brought in for drinking," answer the captain.

"Well — thass fine — let's get started."

* * *

Know what a monastery is? It's a home for unwed fathers.

* * *

A space traveling Martian, after trying in vain to get the gasoline pumps before a filling station to talk, gave up in disgust and reported back to his commanding officer. "Sir, you are not going to believe this," he said, "not only do they just stand there without saying a word . . . but you'll never guess what they stick in their ears."

* * *

Overheard in a Thermo class: "On the last quiz, I got docked five points for having a decimal point upside down."

* * *

One strawberry to another: "If we hadn't been in the same bed together we wouldn't be in this jam now."

* * *

Then we herd about the guy who could always find the liquor, no matter where his wife hid it. He had a fifth sense.

In addition to the A.C.T. and math test, U. of Wis. now has a new entrance exam. They send you to a magic show. If you sit there and take it all in, you pass. If you ask questions and try to figure it out, you can still come to U.W. but you can't major in physics.

* * *

There are occasional bright spots in life, even when caught in a New York City traffic jam. Like getting stuck behind a truck with a big sign across the back, "This truck stops for all signs, railroad crossings, blondes, and redheads. For brunettes it backs up fifty feet."

* * *

Relax, what the hell! You will never get out of this world alive anyway.

* * *

"What a splendid fit," quoth the tailor, as he carried the epileptic from his shop.

* * *

Remember this, my friends: you can fool all of the people some of the time, and you can fool some of the people all of the time, but you can't fool all of the people all of the time unless you're the President.

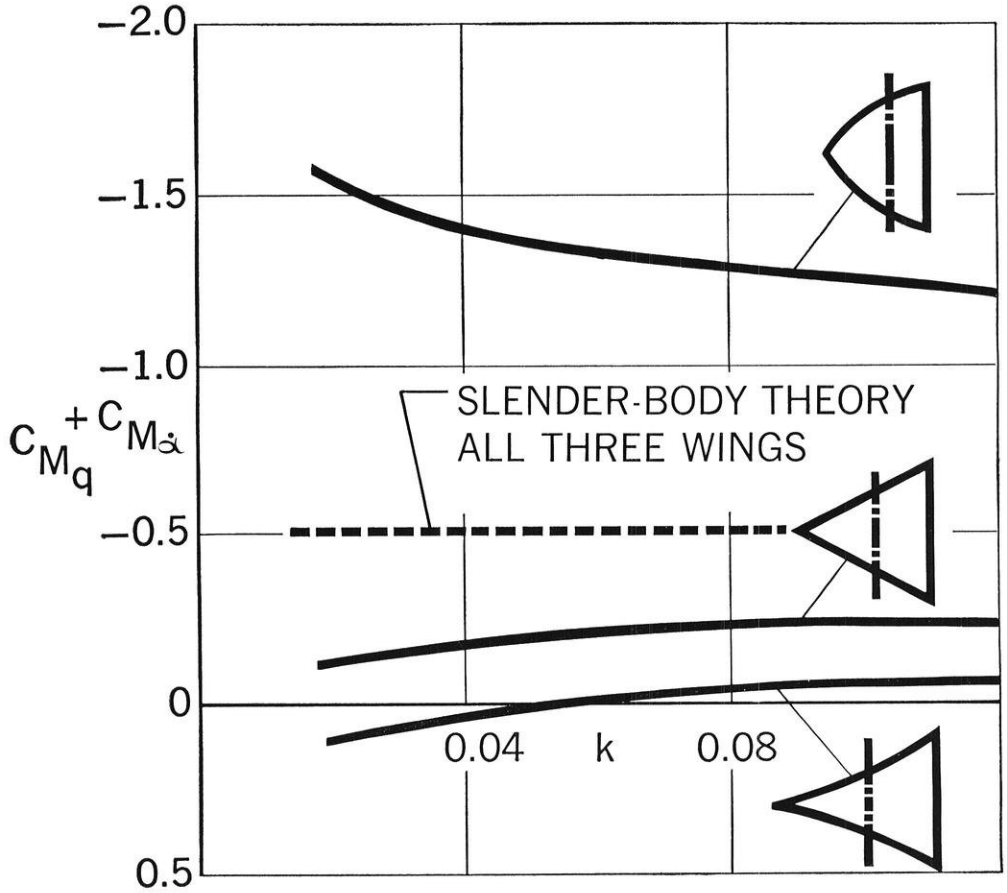
* * *

And then there was the inebriated E.E. who was arrested for feeding the squirrels in the park. He was feeding them to the lions.

* * *

America is the only country where it takes more brains to make out the income tax return than it does to make the income.

Study transonic flow and make good grades.



Like Captain.

Take a look at any campus. Big. Small. Rural. Urban. You see the same thing: guys and gals. Same books. Same looks. Same hopes.

And you are there.

Some students really jam in every bit of opportunity they can grab hold of. Some just drift through.

Which are you?

Here's a good tip: If you join the Air Force ROTC program on your campus you'll know you're grabbing a big opportunity. Financial assistance is available. You'll graduate as an officer—a leader on the Aerospace Team. You have executive responsibility right where it's happening. Where the space-age breakthroughs are. You'll be able to specialize in the forefront of modern science and technology—anything from missile electronics to avionics. You can also be a pilot. You won't get lost in some obscure job with no future.

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And a commission.

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ROTC (A.U.) BLDG. 500 (ARTOI)
Maxwell AFB, Alabama 36112
Interested in Flying ☐ Yes ☐ No

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John C. Heiman, a typical Kodak industrial engineer ▶

◀ Elwood R. Noxon, a typical Kodak industrial engineer

What was crucial six months ago?

Hard to remember.

Six months is a long time to a Kodak industrial engineer. Much happens. Men like these carry on as if the whole company—top to bottom and stem to stern, cameras to industrial adhesives, food emulsifiers to check microfilmers—were a big laboratory for the practice of industrial engineering under the best of conditions. Management finds it pays to let them think so. Happy, they make their advance as strictly professional industrial engineers or hide their industrial engineer's insignia and use their skills to take over other functions in the organization.

Apart from the common denominator of an employer that appreciates industrial engineers and can always use more of them than we get, Heiman and Noxon lead very different working lives. Without assuring these gentlemen against the possibility that six months hence they will have traded specialties, here's the contrast:

Heiman is an accomplished simulation man, a thinker in Fortran, a builder of models for the big computer to manipulate.

He made a good score lately when given six weeks to overhaul the reasoning behind the design of a chemical manufacturing system that had evolved over the last five years as a multi-channel processing plant with problems in line interference and flexibility. He and a colleague, checking each other, spent three weeks writing a program that covered building size, reactor size, product flow, and auxiliary equipment. Debugging took another three weeks. All the while a third man was collecting experience data from the old production area.

The experience data were converted into Monte Carlo input distributions. Various configurations of the proposed production equipment were studied in thirty computer experiments, each simulating twelve weeks of operation.

Result: a system costing 3% more than the original but with 25% more capacity, plus proof that certain manifold connections between reactors wouldn't work.

Noxon works on mechanical goods. He pities industrial engineers who don't get to collaborate with their mechanical engineer partners right from when a project still consists of only rough sketches. He does get called into his projects that early.

His place is in the middle. At his extreme left is the design engineer who created the product idea. Next sits the manufacturing engineer, devising ways for the production boss to transform the idea into reality at the required volume. To the quality-control engineer at the other end of the table is entrusted the whole reputation of the company as it rides on the proposed new product. Between him and Noxon, the production boss awaits instructions. Noxon's job is to sell cost awareness right and left. Unless each of the five gets in his licks, there will be trouble.

Noxon can't stay in the conference room all day. The action is on the factory floor. In putting together job designs, learning curves, and space requirements for the 1970 line, he cannot ignore the ongoing commitment to 1969 product and the lively remnant of '68 production. And cost reductions had better continue when Noxon and his teammates study the "audit assembly" movies from initial production.

Industrial, chemical, mechanical, and electrical engineers who find their profession interesting and would like to practice it in a way that best suits their individual makeup should talk to

EASTMAN KODAK COMPANY, Business and Technical Personnel Department
Rochester, N.Y. 14650

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