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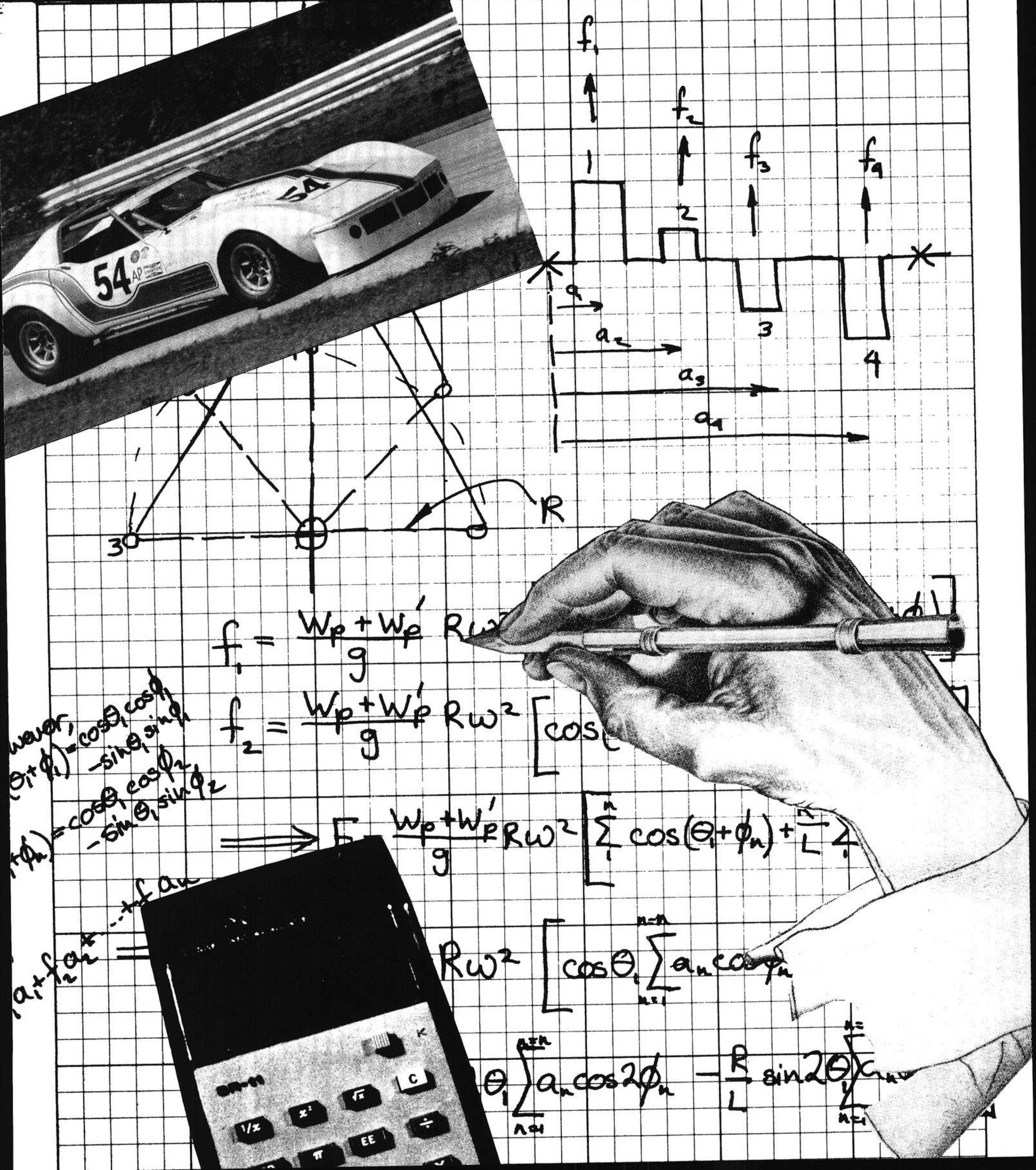
wisconsin engineer



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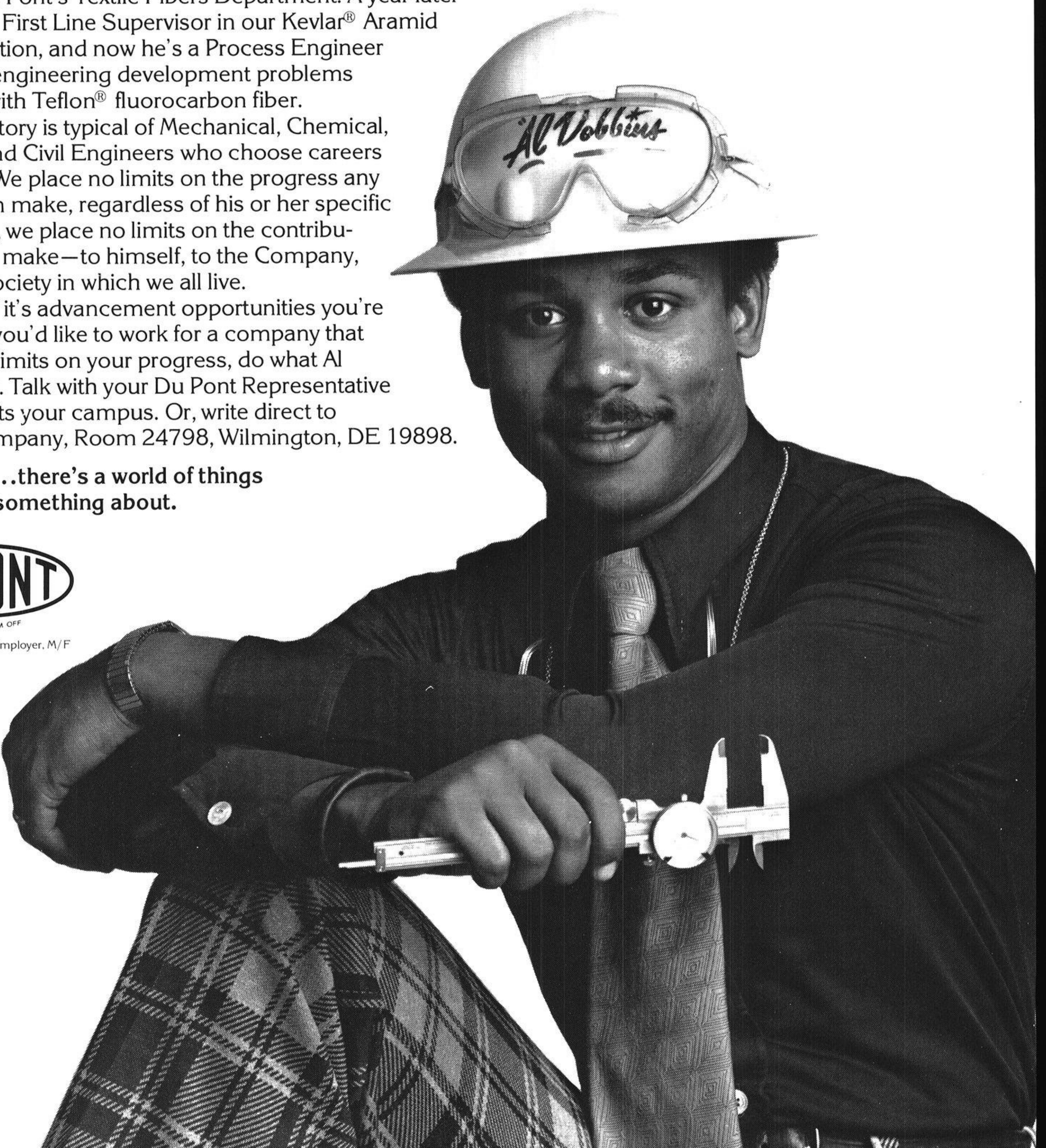

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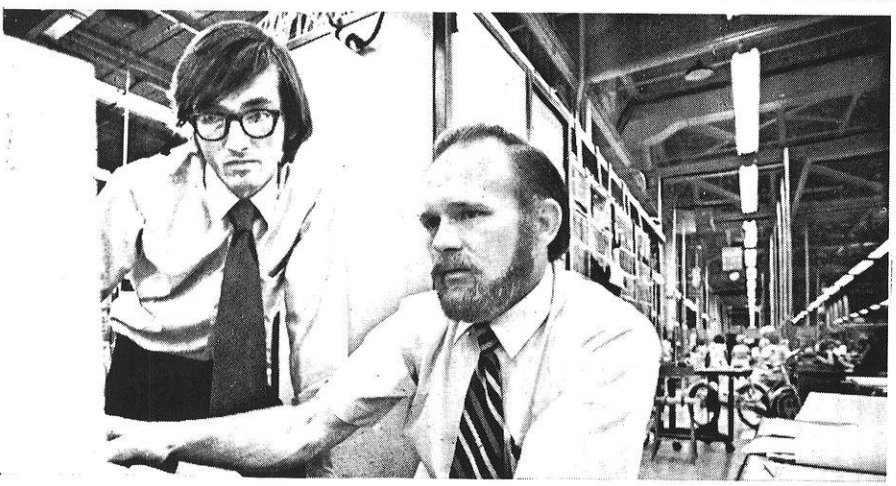

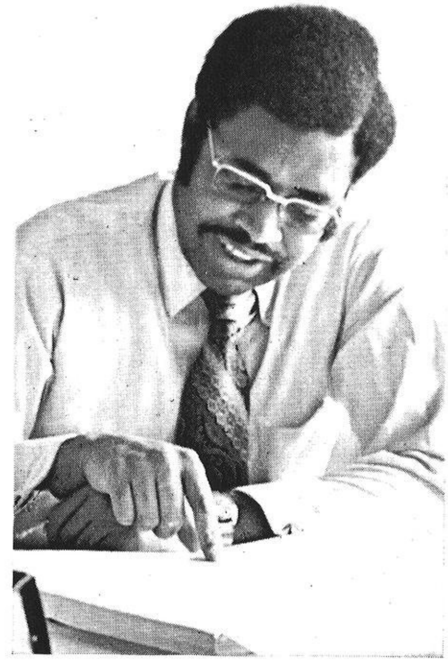

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wisconsin engineer

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Contents

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We Built

We Raced

We Conquered!!

The true story of a race car and the men who loved it.

by Kris Kubly ☞

We made the decision over lunch at Barnaby's. It would be our pastime during the long winter months, our summer recreation and a test of our engineering knowledge. We decided to build a race car.

With that important decision behind us, all we had to do was determine what type of racing we would enter. After observing races for several years, we knew that choosing the correct type of racing and entering the correct class was crucial. It takes money to be innovative, and, not wishing to enter with a handicap, we decided to play it safe. We bought a used Corvette, a car that has dominated its class of sports car racing for at least five years. There's good reason for that—its high performance components are widely available, it has superior engine design, and, there's lack of competition for it. Another benefit was Corvette parts could be obtained quickly and reasonably.

Then we faced the nemesis of all racers, the budget. Since we would be doing all the designing and fabrication ourselves, (using mostly Chevrolet components), we felt we could keep the cost reasonable. We would begin work in the winter and roll the completed racer out of the shop in the spring for a total cost of $4000.

Well, we had never built one before.

Spring 1972 came much more quickly than we had expected. We got a little fishing done, less work than we were paid for, and no race car. It wasn't that the task was so difficult. It just seemed that fabricating the little brackets to hold on miscellaneous items took 10 times longer than it should have. We also discovered that Madison was not the best city for materials and services necessary for fabrication.

No racing was done during that summer either. In fact, about all any of us accomplished was thinking about, talking about and working on the race car. Our budget limit went speeding by. But who could've stopped at this point? After all, so much money had been spent, so much time invested.

One warm fall day, we rolled the car out of the paint shop, and stood back to see the awesome transformation of those thousands of pieces into that great white monster. It was an accumulation of welding class, thermo, strength of materials and I.C. engines. It had a very simple but effective roll cage constructed of tubular steel. The body was stock, and only the exposed exhaust system and tires gave away its intended purpose. We felt quite confident with the factory Daytona Springs which we had intalled, but the anti-roll bar diameters were simply guesses. We scraped together the money for one set of tires and just made it to Drivers School for licensing in September 1972.

* * *

That winter we redesigned the entire vehicle. We relocated the oil cooler, revised anti-roll bar/spring combinations, and cleared up problems related to the seemingly unimportant windshield wiper reliability. None of the wheels had fallen off, though, and we were confident we were on the right track. Throwing all caution and reason to the wind, we unanimously decided the white monster was not intended for club racing. With only one Drivers School session under our belts (most racers attend two), we set our sights towards the Watkins Glen Trans Am that spring.

* * *

We replaced our Drivers School engine with a 482 CID engine. We studied Society of Automotive Engineers papers and vehicle dynamics texts to allow us to rough calculations to determine roll couples and require spring rates and anti-roll bar sizes. High and low pressure areas located on the vehicle were utilized for cooling air intake and outlet. We paid strict attention to bearing lubrication and preload. All bolts and fasteners were carefully selected and assembled.

Just looking at the size of the 482 hulking in the corner was enough to convince us that additional safety items were necessary. A complete fire extinguishing system and safety fuel cell were installed. A fire wall was constructed behind the driver and all fuel and oil lines were fabricated of teflon hose wrapped in stainless steel braid. Larger tires were also necessary, which in turn necessitated fender modifications. The additional power also required sturdier transmission, drive shaft and differential components.

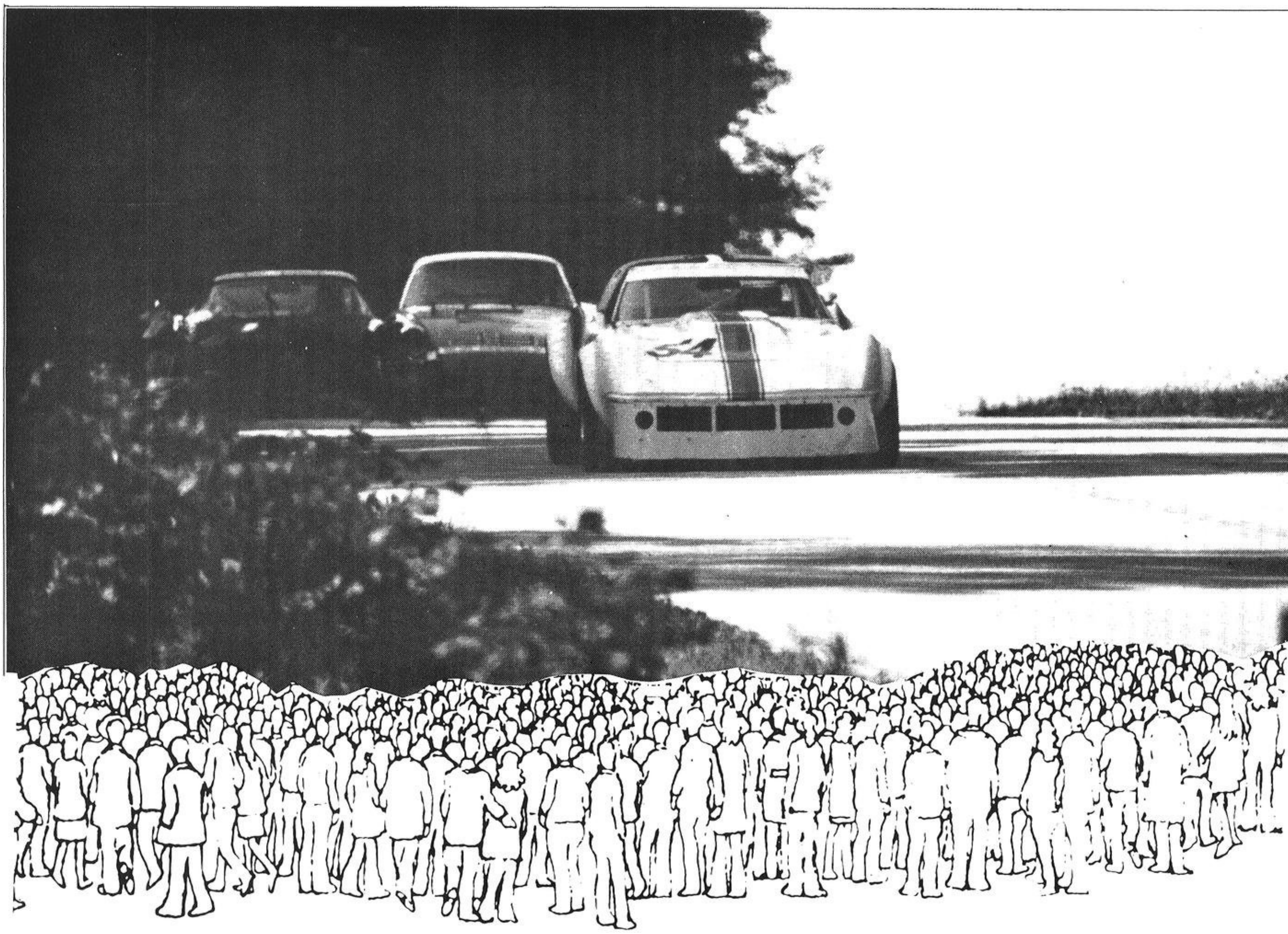
By the time spring came, the original car had been virtualy replaced piece by peice.

We rented a track in May 1973, and tried once again. The 200 horse power increase was obvious, as the car virtually jumped from one corner to the next. Our selection of anti-roll bar combinations were such that no improvement was found during the next two years of testing and racing.

We were somewhat surprised that no one appeared to be worried about our presence at the Glen. Perhaps it was that the car, completely white with numbers on the side, advertised to the world that we were rookies. The qualifying sessions did little to alter this impression. We had selected the wrong axle ratio and could not manage a competitive lap time. The situation worsened during the race when the weather, alternating between wet and dry, forced us to attempt many tire changes. It was then that we discovered the difference between a 20-second pit stop and a five-minute pit stop. It was time to go home, and no one had even noticed we were there.

Our discouragement lessened somewhat when we saw that the dates of the Montreal-Sanair Trans Am and the Mid-Ohio IMSA race conflicted. We were sure that the majority of the competitors would opt for the Mid-Ohio race to avoid the long haul to Montreal. We even planned what we would do with our share of the prize money as we prepared for Canada.

We decided to use silicone brake fluid for the Montreal Trans Am, thereby eliminating fluid boiling due to the high temperatures



generated by the brakes. Several new differentials were assembled to provide the proper ratios for different track conditions. We also updated our tire changing equipment. All roads led to Montreal.

We got a hint of what was to come upon arriving. Although none of us spoke French, the message came through loud and clear when the toll gate attendant smiled and shouted, "Porsches" as he pointed down the highway. He was referring to our competition. The mirage of prize money evaporated before our eyes.

Except for one major competitor, the field was the same as it had been for the previous race. This meant we would be up against factory Porsches, Escorts and Capris, as well as several professional teams of Corvettes and Camaros. We decided to unload anyway, encouraged at the thought of the 3.70:1 final drive ration and the secret brake fluid.

At first, it seemed all too easy. We posted the fastest qualifying time in the first qualifying session. Suddenly, competitors were poking their heads all over the car, this time, for some reason, they were quite interested in us. Spectators must have wondered what this white mystery car was doing going so fast on the track, but, unfortunately, we couldn't answer their questions.

By race time we had been bumped on the qualifying grid to sixth position. (We still find it inexplicable, but the very tight race track seemed to have an advantage for one or two of the larger vehicles, while it should have been a Porsche track). In any event, we were not complaining. The race gods were with us when we selected our tires for the race. Half of the teams went to the starting grid with rain tires due to the intermittent showers, while we decided on slicks.

As you might guess, the first laps saw us drop five positions. Suddenly, the rain stopped, the sun came out, and as the track began to dry the situation was reversed. While many of the competitors were diving into the pits for tire changes, nothing could stop the white monster. Positions were changing at an incredible rate. The lap chart showed we were unchallenged for second place and just over one second behind the leader. (Later we learned from our driver and other competitors that we held an advantage in both power and brakes on that day). The lap charts forecasted we would take over the lead and, if all went well, win quite easily. All did not go well.

The half way point in the race was marked by our car entering the pit straight in second gear, reaching 7,000 RPM, changing gears and misplacing a connecting rod through the side of the engine block. It was quite a spectacular failure with the oil smoke and metal particles flying all around. At first, we were desolate. But even if Road and Track wouldn't be featuring us on their next cover, we had proved some thing to ourselves.

By now, cost over-runs were outrageous. We could no longer afford

"While many of the competitors were diving into the pits for tire changes, nothing could stop the white monster."

to gamble with .120 inch over-bores and decided on two compromise engines. A 461 and a 427 were selected. We became students of metallurgy and learned how to reduce the height of our front springs without changing the spring rates. We divined the real differences in bolts and nuts. We learned about real differences in bolts and nuts. About bearing life and lubrication. About aerodynamics and driving strategies.

During the 1973, 1974 and 1975 seasons we started 19 races. Of those races, we recorded 12 firsts, 3 seconds, one third, and one fifteenth (Watkins Glen). Only twice in that three-year period did the car fail to finish. In addition to the engine failure described above, we experienced a broken universal joint at the Elkhart Lake Trans Am.

If a lesson can be learned from this race car Odyssey, we believe it must be that it is possible to do nearly anything you want, as long as enough motivation and information are available. We also discovered we could do things better ourselves than have them done by others, simply because we cared more about the results.

Undoubtedly, our engineering educations were of great assistance. This became obvious as we observed our competitors. Typically, they had not tested the spring rates or proportioner valve calibrations. They had usually failed to recognize the relationship between bearing pre-load and heat dissipation. They had generally become too experienced to use a torque wrench on fasteners and thought the markings on the heads of bolts were codes for the manufacturer. However, there were also several very successful teams that had no scientific background. Those teams had invariably become successful, however, through trial and error during many seasons of competition.

We were convinced that our success arrived as quickly as it did as a significant result of the people, books and time that make up an engineering education.

Perhaps the day will come when Race Car 350 will be offered as an engineering elective. If you can afford the tuition, take it.

Kris Kubly *is a mechanical engineer employed by Easton and Associates. He graduated from UW-Madison Engineering School in January 1972.*

Toxic Substances and the Bureaucratic Quagmire

by Steven Schopler

"Suddenly, as if the were newly discovered, PCBs have become a cause celebre of many organizations and individuals seeking their universal ban."

Virtually everyone from the tot to the tottering is aware of the national effort to fight environmental pollution and occupational safety hazards. A glance at city skylines or the shorelines of our waterways will convince even the skeptic that real progress has been made in eliminating dangerous and repulsive pollutants from our air and water. Equally hazardous contaminants have been eradicated from our workplaces — and for these successes the environmental movement is rightly proud. But in 1976, the question is no longer "Do we want safe working conditions and a clean environment?" What we must now ask ourselves is "How safe, how clean, and how much are we willing to pay for these benefits?"

A growing number of Americans are concerned that very small improvements in our environmental quality are no longer worth the enormous investments they require. Consumers pay doubly for these improvements since we not only must bankroll industry's investment in pollution control but pay taxes which support a vast toxic substances bureaucracy.

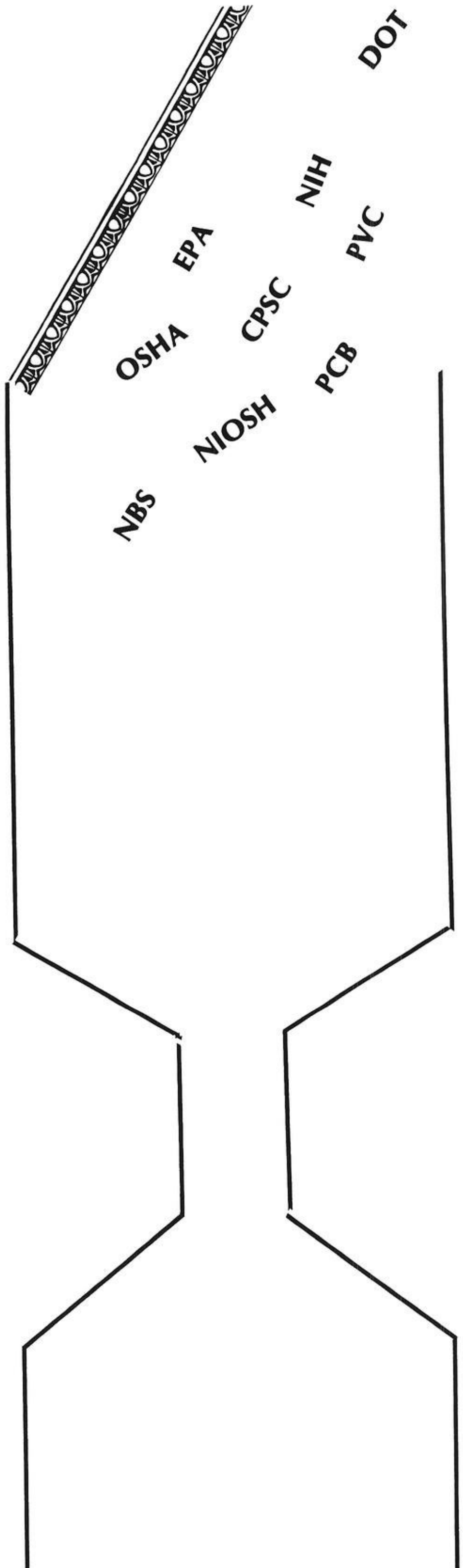
The federal government has created within itself a veritable alphabet soup of agencies whose purpose is to protect us from the toxic substances that are the distasteful realities of twentieth century life. Among these agencies are OSHA (Occupational Safety and Health Administration), EPA (Environmental Protection Agency), FDA (Food and Drug Administration), CPSC (Consumer Products Safety Commission), NIOSH (National Institute for Occupational Safety and Health), GAO (General Accounting Office), NIH (National Institutes of Health), DOT (Department of Transportation), NBS (National Bureau of Standards), and others. All have established regulations or research programs involving toxic substances. How can these substances affect us as engineers and how can we deal with the bureaucratic quagmire of toxic substances control?

Toxic chemicals can affect the lives of millions. Consider the recent developments concerning Polychlorinated Biphenyls, or PCBs. These are members of a family of compounds wherein chlorine atoms are substituted for hydrogen atoms on the biphenyl molecular "skeleton". PCBs were used extensively in the United States from the 1940's to 1971. Because the compounds are chemically inert and thermodynamically stable to high temperatures, PCBs found wide application as plasticizers in paints, textiles, investment casting waxes, inks, paper products, and other surface coatings. Because of their resistance to explosion and high dielectric constant, the compounds were (and still are) used as a dielectric fluid in power capacitors and transformers large and small. The greatest quantities of PCBs were manufactured for use in electrical applications, as heat transfer and hydraulic fluids, and in carbonless copy paper.

In 1968, after millions of tons of PCBs had been manufactured and distributed, a leak in a PCB-filled heat exchanger in a Japanese rice oil factory resulted in the accidental poisoning of thousands of Japanese citizens who consumed the contaminated oil. The incident caused on immediate fatalities, but the consequences of the event included several miscarriages, persistent cutaneous acne, facial edema, and other symptoms which have persisted in the victims of PCB intoxication to this day.

Soon after this outbreak, the toxicity of PCBs became widely known and Monsanto Industrial Chemicals Company, the only U.S. manufacturer of PCBs, voluntarily restricted its sales to "closed systems" applications. Engineers sought substitutes for PCBs and better methods for controlling them in the environment. Although the chemicals appeared to be under control by Monsanto's restricted sales policy, further study revealed that PCB concentrations were continually rising in air and water samples from across the United States. Due to their lipophilic properties, PCBs accumulated in the fatty tissues of freshwater fish and marine life. Toxicity studies have shown PCBs to have harmful effects on monkeys in diet concentrations as low as two parts per million (ppm).

Suddenly, as if they were newly discovered, PCBs have become a cause celebre of many organizations and individuals seeking their universal ban. PCBs have just as sudenly become the headache of the year for industrial



capacitor manufacturers, investment casting foundry operators, and paper recyclers threatened with federal regulations requiring the expenditure of millions of dollars for the monitoring and control of PCBs at parts per million levels in their effluent discharges. (It is ironic that the environmentally concientious paper recycling industry should bear much of this cost. The industry's only connection to the chemicals is in the recycling of years-old paper products that already contain them as a component of inks and coatings.)

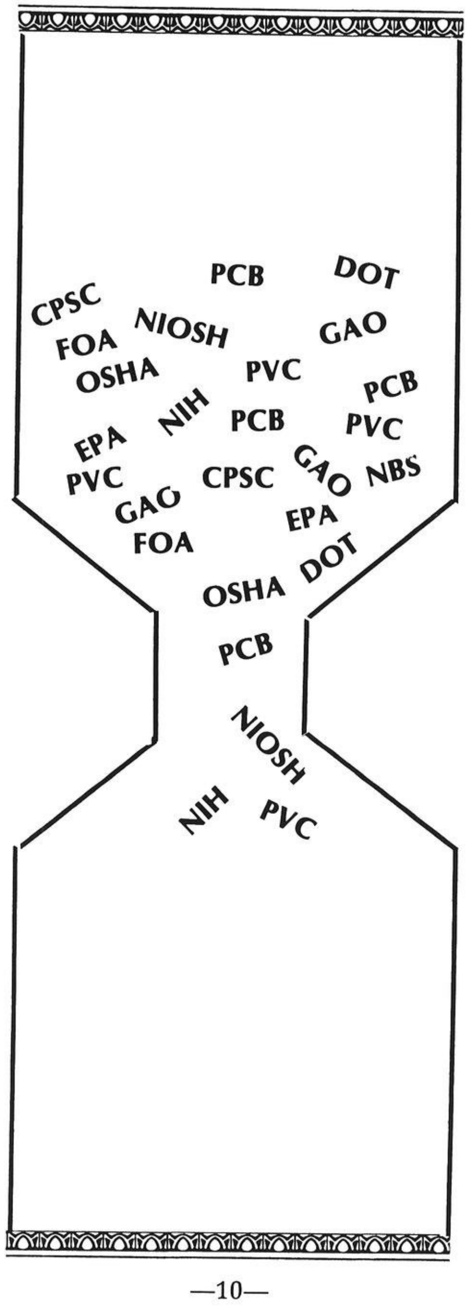
Keeping in mind that not a single case of PCB intoxication has ever been reported in the United States, consider the expenditure and involvement of the federal bureaucracy. The EPA has held two national conferences on the subject, sponsored numerous studies, collected volumes of information, and after more than 24 months of deliberation, published what could be called "guidelines" to hasten the elimination of the chemicals from industrial use. The FDA has ordered the destruction of tons of commercially caught fish found to contain more than the FDA limit of 5 ppm. PCBs. The FDA has also collected volumes of data in an as yet incomplete attempt to modify its own maximum allowable contaminant levels for PCBs in processed food, food packaging materials, milk, and baby foods. The Department of Transportation has been involved in devising safe means of packaging and transporting PCBs as well as developing procedures for handling PCB spills. The NBS is in the process of developing standardized mthods for the quantitative analysis of PCBs in concentrations as low as a few parts per trillion. OSHA and NIOSH are concerned with the protection of workers involved with the handling or manufacture of PCBs or PCB-containing products. The GAO audits the functions of all these other agencies, making certain the taxpayers get their money's worth in toxic substances protection.

". . . despite the research and extensive study undertaken by industry and the academic community, decisions on toxic substances are often based on very little scientific data."

These agencies are under constant pressure from proponents on both sides of the issue. Environmentalists want stricter, more positive action on PCBs and have initiated lawsuits to get it. Some industries, such as Wisconsin's paper recyclers, claim they will go bankrupt from the vast expense of "nonproductive" pollution control equipment that may be required by proposed federal requirements. In 1975 over 15,000 jobs were lost as pollution control requirements forced the closure of more than 75 plants in the United States.

Another of the many examples of the toxic substances dilemma is the controversy surrounding the plastic Polyvinyl Chloride, also known as PVC. This material is used in products too numerous to mention. When OSHA and NIOSH studies revealed that workers in PVC plants had developed an unusual number of cases of angiosarcoma, a rare liver cancer, the cause was traced not to polymerized vinyl chloride, but to vinyl chloride monomer gas which escaped the polymerization process. Besides the concern for worker exposure at vinyl chloride plants expressed by OSHA, the FDA became aware of vinyl chloride monomer migrating by diffusion from food packaging plastic to the container contents. Next, the EPA sought to locate sources of vinyl chloride monomer escaping to the atmosphere or leaching from landfill sites into fresh waters.

In addition to the cost of the bureaucratic involvement in toxic substances (EPA's budget for fiscal 1975 and $743 million), the cost of industrial controls must be added. In the case of PVC, the B.F. Goodrich Company, one of the largest PVC manufacturers in the world, spent $36 million in the company's largest research effort ever, in order to meet the federal requirements. OSHA's 1 ppm employe exposure limit (averaged over a time-weighted 8 — hour period), EPA's atmospheric emissions limit, and FDA's food packaging standards were all met or surpassed by B.F. Goodrich's new "clean" polymerization process for vinyl chloride. Certainly these actions have resulted in a marginal improvement in our environmental quality, but the costs of implementing the new standards industry-wide will be reflected in higher costs to all consumers.



Destined to increase industry's expenses still further is pending legislation known as the Toxic Substances Control Act. This bill gives the EPA control over the manufacture and distribution of chemcial substances in interstate commerce. Under the act, the EPA would also be able to screen chemicals before they are released to the market, with manufacturers required to submit their own test data to the EPA. The bill was introduced in February 1975 by Sen. John Tunney (D-Calif.) who said, "The premarket screening provisions of this bill go to the very heart of a proper toxic substances program. Without it, or with a limited review (as prescribed in similar bills), there is virtually no way that vinyl chloride—like experiences might be avoided on a timely basis in the future."

EPA Administrator Russell Train estimates that the bill would cost the chemical industry $45 million annually. The Manufacturing Chemists Association estimates these costs at $1.3 **billion.** The actual cost of the bill's enactment is likely to be somewhere between these two extremes, but whatever the cost, we consumers will bear it in the end.

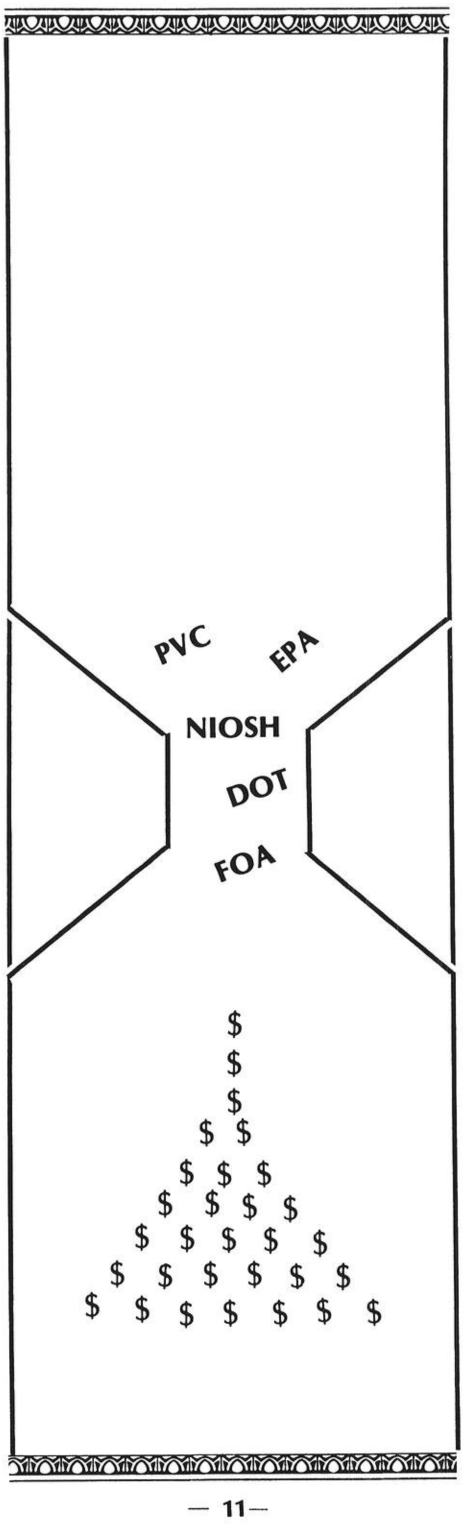
One of the biggest complaints industry registers against the toxic substances bureaucracy is that despite the research and extensive study undertaken by industry and the academic community, decisions on toxic substances are often based on very little scientific data. Last March, Glenn Schweitzer of EPA's Office of Toxic Substances stated that, "At the present time decisions are being made on the basis of very sparse data."

A prominent example would be

last December's decision by Russell Train to order an immediate halt to most uses of the pesticides Chlordane and Heptachlor, despite an earlier recommendation by an EPA administrative law judge that the carcenogenicity of the pesticides had not been proven. Administrator Train replied that it is now necessary to find conclusively that harm will come to humans if the pesticides are used; rather, he based his action on the finding that their continued use would likely result in an "unreasonable risk to man." Train's decision temporarily suspends the use of Chlordane and Heptachlor. Hearings are to be held to determine whether to permanently cancel all use of the chemicals. The hearings are expected to last 18 months.

This kind of reasoning rankles industrialists who claim that current methods of testing chemicals and formulating federal regulations on their use are stacked against them. First, it is impossible statistically to prove that a chemical does **not** cause harm. It is only possible to show with a certain level of confidence that a chemical is **likely** to cause harm. Secondly, present methods of chemical screening reject the concept of a "no effect" level of a chemical simply because such a level cannot be demonstrated for the reason just mentioned. Since the "no-effect" level is disregarded, laboratories test chemicals by subjecting animals to doses many times greater than a human would be likely to encounter. In this way, the chances of possible tumor formation are greatly accellerated, reducing the time span of the test which otherwise would take years to complete. If malignant tumors are found in the animals, the **carcenogenicity** of the chemical is "proven". If benign tumors are found, the **mutagenicity** of the chemical is "proven." If the animals' offspring are deformed, the chemical is a proven **teratogen.**

To complicate matters still further, analytical techniques are being improved to detect lower and lower levels of chemical contamination in air, food, and water. This opens the discussion to the question "When is a substance 'free' of chemical contaminants?" To give some idea of the quantities involved, consider that one part per trillion is roughly equivalent to the contamination of 15,000 cubic feet of pure water by a single grain of salt. Chemists have already detected some chemical contaminants at parts per quadrillion levels!

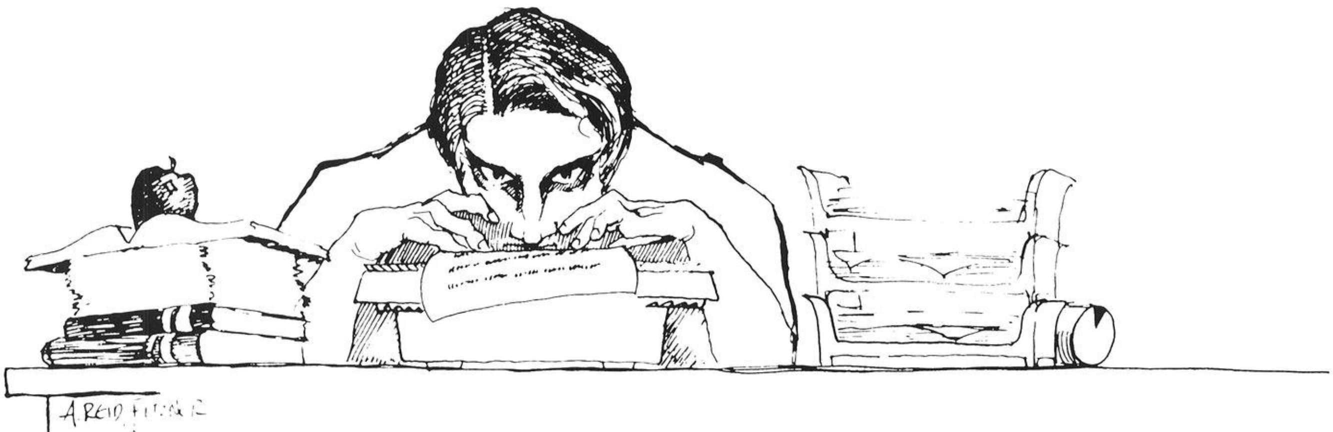


The question that arises in the engineering and industrial community is "What can be done to protect our workers, our environment, and our community reputation from an inadvertant conflict with the plethora of federal toxic substances regulations?" Since there are regulations governing the use, transportation, and disposal of substances from the most common solvents (e.g. ketones) to the most deadly radioactive elements, the only answer to this question is simply "Be aware!" Every toxic substance and occupational safety regulation may be found in the Code of Federal Regulations (CFR). This is a 50—volume set containing every federal regulation now in effect. It also includes comments on the intent, enforcement, and penalties for the violation of each.

New regulations are additionally published in the Federal Register, a daily periodical containing written accounts of all actions by federal agencies. Although federal regulations are most complete in their published forms, effective use of the CFR or the Federal Register is not simple. An easier approach is to telephone the appropriate Washington agency and make an inquiry. Once the correct person is contacted, one can usually obtain enough information to make better use of the written regulations. The United States Government Manual 1l975/1976 is one of the best available directories of federal agencies. It contains a brief description of the function, structure, and leadership of every government agency as well as important addresses and phone numbers.

To anyone who expects to be professionally involved with chemicals of any sort - from cleaning fluid to heavy water-this writer advises "Be aware of those federal regulations!"

Steve Schopler *is a senior in mechanical engineering, currently studying bio-medical engineering. He is also a science and technology intern for the Wisconsin Legislative Council Staff.*



Dear Editor:

I am currently employed by G.T.E. Automatic Electric Laboratories Incorporated located in Northlake, Illinois. My job consists of the design and development of service circuits for various sizes of common control type telephone switching systems.

For students interested in communications circuits I strongly recommend the communications laboratory (E.C.E. 455). The design project in that course is a rare and valuable practical experience. A good balance of communications theory with circuit theory is vital. Digital, linear, and non-linear circuit theory should all be covered. Any additional studies in these areas would be helpful; particularly digital logic design.

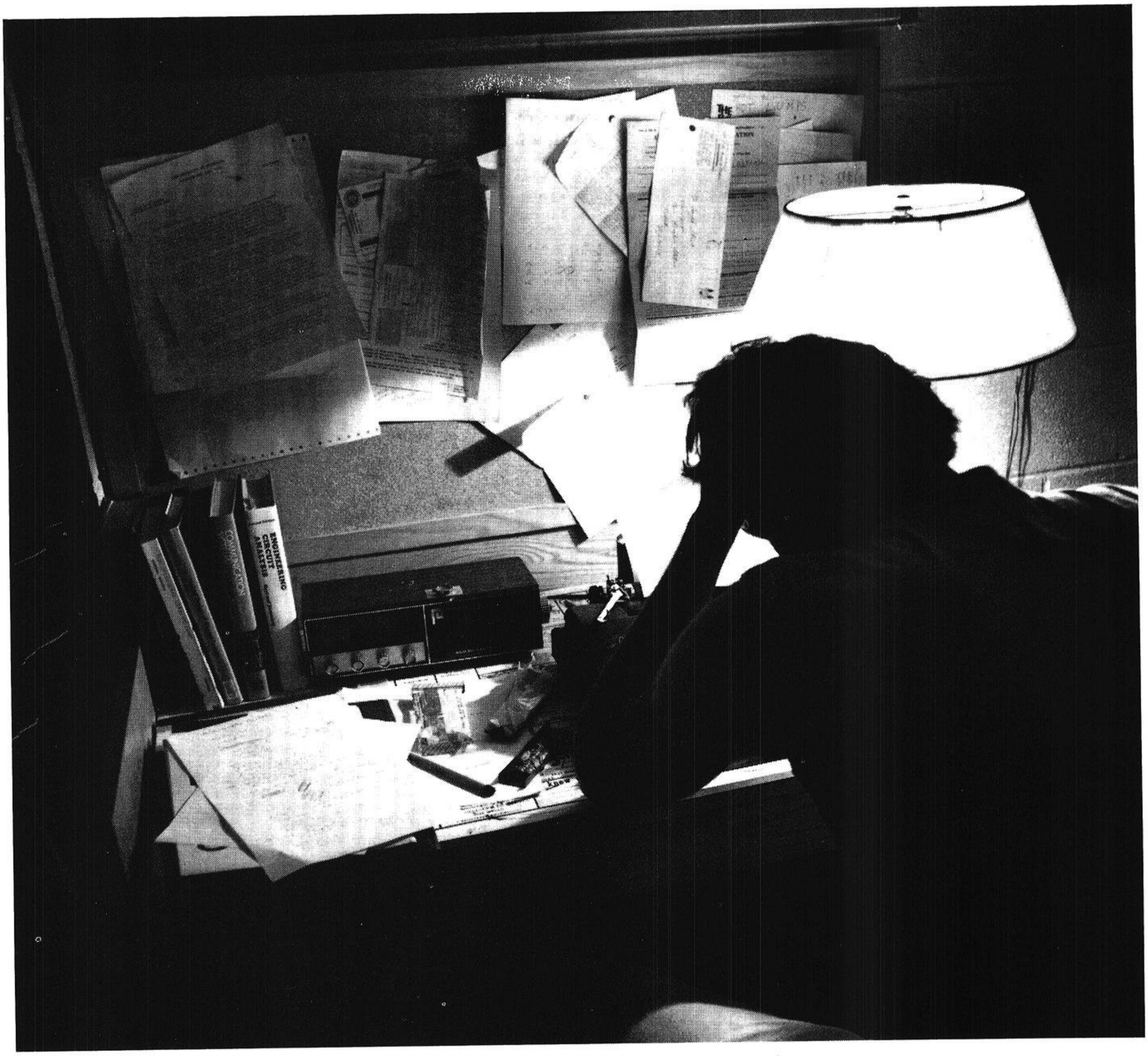
Stephen A. Saindon

Editor:

I am now working at Wisconsin Electric Power Company in Milwaukee, Wisconsin. Since graduation have been involved in a one-year formal training program. This consists of assignments ranging in length from two to five months in four locations—two in power plants, one in Budgets and Results, and one in Engineering and Construction. Specific assignments have included turbine efficiency tests, heat rate tests (BTU's/KWH), designs to repair or improve plant facilities, and design and installation of test equipment for the environmental department.

Two courses I have found very useful in my work are mechanical design and fluid mechanics.

Robert R. Hubinger



Hang in there, baby!

We have good news for you.

With a little cooperation on your part—more than a little, actually—you will awaken to find yourself transformed into a scarce commodity, which is even nicer than turning into a lovely butterfly.

You will owe this good fortune to two notions, both false: 1) engineering has proved an evil profession, 2) therefore engineering jobs are drying up. The prevalence of these notions in some circles has cut down the competition for your share of the action in the world.

Yes, there has been a slackening. There have been times when an emerging engineer might have had a choice of 30 offers. Today it may be only 5 or 6. Check with your non-engineering friends on campus how many offers of professional-level employment they get these days. But then they may not *like* engineering. (Switch out fast if you hate it yourself.)

One rumor is true: that your engineering faculty, despite their apparent friendliness, is out to make it as tough as possible for you. It is your ability to survive their efforts to grind you into the wall that makes you the precious commodity you are. Perhaps you already knew that.

And what's in it for you? Good access to the things that money can buy and more of a chance than most people get to shape the future as you think it ought to be shaped. We are not the only organization that draws its decision-makers from among those who came in expecting to spend their careers contemplating engineering tables.

Nor are we the only company that could have signed this ad. No matter how many offers you garner, you can accept only one. A note about yourself is a first step toward determining whether that offer ought to be from us. Address it to Kodak, Business and Technical Personnel, Rochester, N.Y. 14650.

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Now what you need to know is which companies can offer you the best opportunities. We think you'll find General Electric is one.

We're a high technology company. And that means we have to have managers who understand technology—women and men—to run the place.

Today, over 60% of the top managers at General Electric hold technical degrees. In fact, over 65% of the college graduates we hired last year held technical degrees.

Of course, just leadership ability and a technical degree won't get you into management. First, you're going to need solid engineering experience and a broad understanding of business.

And we have a lot of ways to help you get it.

One is our Manufacturing Management Program. A two-year program of rotating assignments that gives you broad experience with different products and manufacturing processes.

Another is our Engineering Program. For engineers with an interest in product and systems design and development. There's also a Field Engineering Program, a Technical Marketing Program, plus a number of programs sponsored by product operations.

And all with just one aim. To give you all the responsibility and all the perspective you need to move into management. As fast as you can manage it.

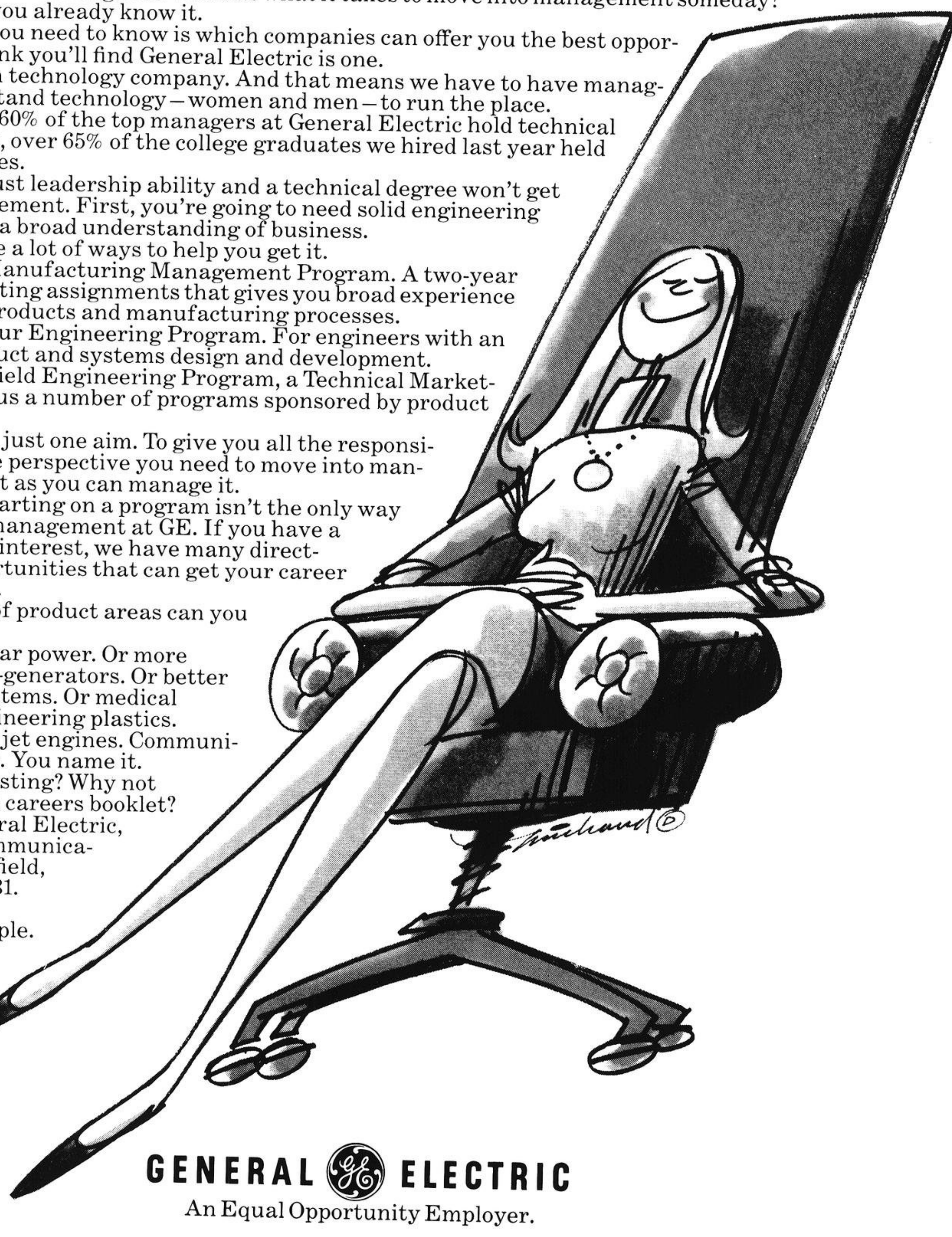
Of course, starting on a program isn't the only way to make it into management at GE. If you have a specific product interest, we have many direct-placement opportunities that can get your career started fast, too.

What kinds of product areas can you work in at GE?

Maybe nuclear power. Or more efficient turbine-generators. Or better mass-transit systems. Or medical equipment. Engineering plastics. Cleaner, quieter jet engines. Communications products. You name it.

Sound interesting? Why not send for our free careers booklet? Just write, General Electric, Educational Communications, W1D, Fairfield, Connecticut 06431.

Progress for People.



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