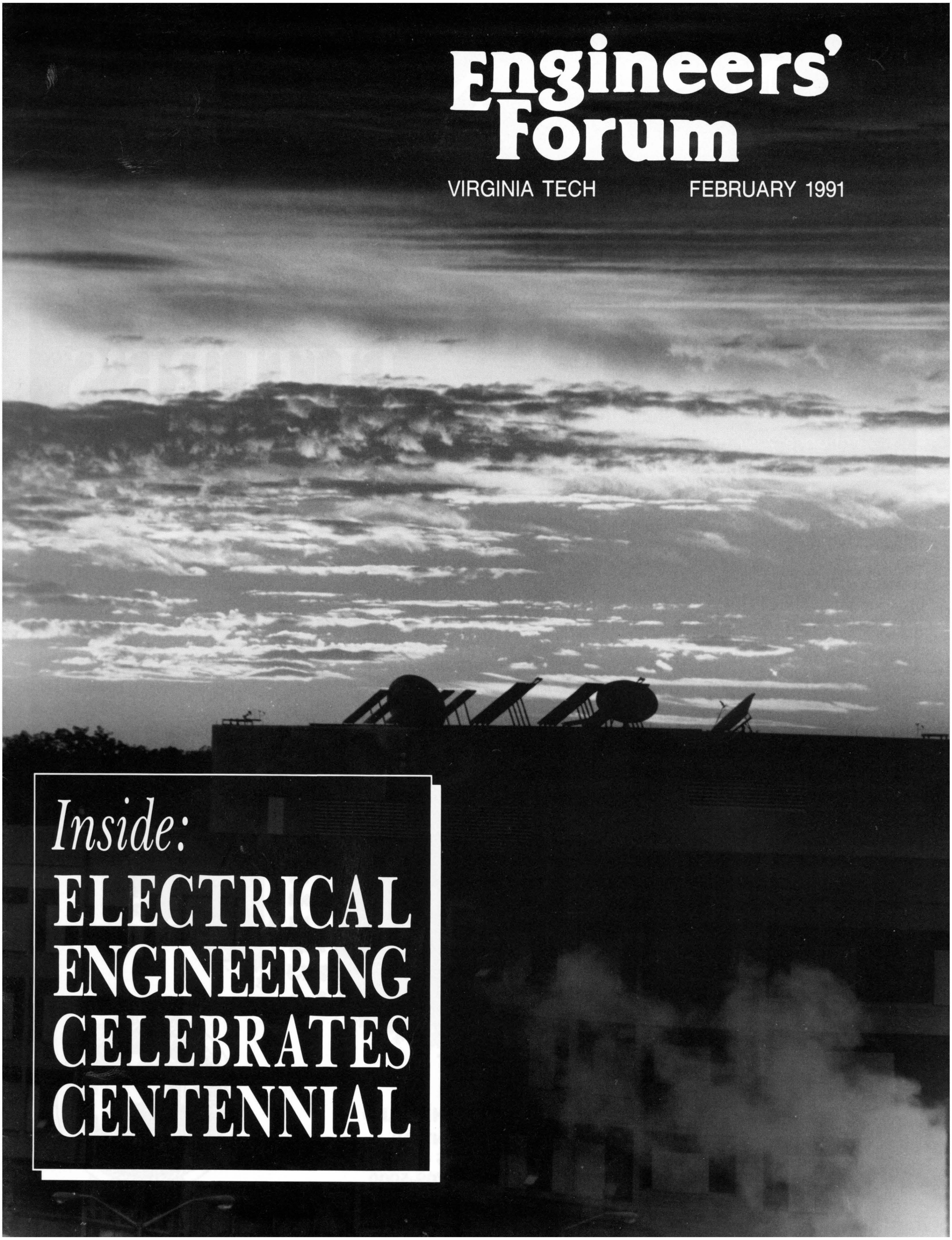
Engineers' Forum

VIRGINIA TECH FEBRUARY 1991



Inside:

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ENGINEERS

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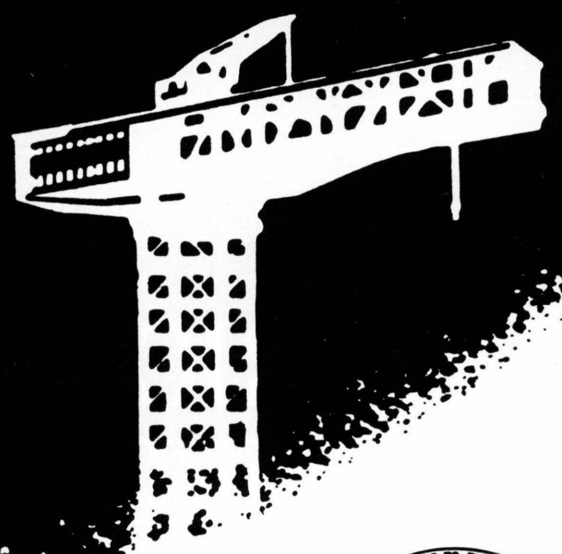

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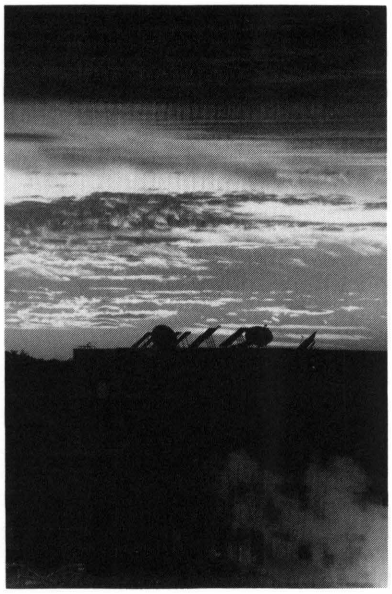

ON THE COVER

Solar cells silhouetted against an evening sky speak of environmental concerns as Virginia Tech's Bradley Department of Electrical Engineering prepares to celebrate its centennial.

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Engineers' Forum

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EDITOR'S PAGE

American car companies struggle to overcome reputation with consumers

American car companies' seemingly endless chase after Japan's share of the U.S. car market inevitably results in one conclusion; our quality and reliability is second-rate compared to Japan's cars and other imported cars. This sentiment has been expressed time and time again by the U.S. consumer.

Certainly Americans want a car that is safe, well-built, economical and reliable for a reasonable, competitive price; human nature demands this. Our friends in Japan have this concept nailed, considering their modest but painful 8% share increase in the U.S. auto market over the last decade. Conversely, American car giant General Motors' (GM) share of the market plunged from a comfortable 46% to a level of blatant mediocrity at 36%. Obviously something needs to be changed in the American car producer's philosophies and practices.

Amid the past decade's demise of American cars, GM has been working on an experiment of sorts which could dispute the outdated bureaucracies where union and management must argue over everything. This $3.5 billion experiment to GM has found its home in Spring Hill, Tennessee. The experiment which GM has put overwhelming faith in is a new car line known as Saturn. Recently, this new car line has started to flood U.S. television sets launching a massive advertising campaign aimed to persuade car buyers. A massive campaign is just what Saturn will need to achieve its goal; to compete with the Japanese in the increasingly important small car market.

Saturn plans to shatter the mold of other U.S. car companies, even the other GM plants. A bizarre new relationship between the United Auto Workers (UAW) and Saturn management will be unfolded where these supposed adversaries work together in every area of the business. Additionally, assembly operators will actually have authority and responsibility as they will be grouped into over 165 support teams. Unorthodox as it sounds, maybe U.S. car companies are finally starting to realize the recent results of a $5 million MIT study where Japan's advantages were found to be teamwork, efficient use of resources, and the obvious overwhelming commitment to quality.

Wouldn't one expect every car producer to have this 'overwhelming commitment to quality?' Obviously not, since consumers' most evident complaint with American cars is a lack of quality. But what is this mysterious characteristic which has filled so many U.S. consumers' minds? Rather than worry about what quality is, a more immediate aim for American car companies should be how quality is achieved.

Perhaps one of the best explanations of this is given by Herr I.V. Hammer of Mercedes Benz in Kendell Giles' story titled "Mercedes Benz: A Lesson In Quality." Hammer tells us "Quality cannot be controlled out — it is achieved by design." Hopefully the three models of Saturn, the SL sports sedan, the SL2 sports touring sedan, and the SC sports coupe have all adhered to Hammer's golden rule concerning quality.

Of course even if Saturn proves to be the most reliable car ever built, no one expects GM's blemished image to be reconciled overnight. However, remembering that facts do not lie, consumers might be interested that, compared to five years ago, GM cars have had 53% fewer defects. In addition, Buick, a division of GM, was ranked fifth on the J.D. Power survey of initial quality, higher than both Honda and Acura. So where is the flaw in that?

Maybe it is time for consumers to stop harping on the past inefficiencies of U.S. cars and take a look at the improvements they have made and continue to make. Possibly Saturn will open the eyes of America and prove that the U.S. is still a contender.

Jonathan S. Hess

Jonathan Hess, Editor

Special events are part of plans to celebrate

"The Centennial of Electrical Engineering"

by Grady J. Koch

1991 marks the hundredth anniversary of Electrical Engineering at Virginia Tech. The Bradley Department of Electrical Engineering is celebrating this event throughout the year with a series of distinguished speakers, historical displays, Centennial Seminars, and Open Houses.

Centennial Seminars began on January 28 with Dr. Gerald Wilson, Dean of Engineering at Massachusetts Institute of Technology. The next seminar on March 26 will be with Dr. Robert Lucky, Executive Director of Communications Science Research at AT&T Bell Labs, who will be discussing latest advances in communications. In September Erich Bloch, former Director of the National Science Foundation, will be speaking.

In addition to these Centennial Seminars, the Bradley Distinguished Lecture will be on April 9 with Dr. Paul Chu. Dr. Chu, of the University of Houston, is one of the scientists who recently revolutionized super-conductivity.

Several Open Houses are sponsored for people to tour facilities. The first will occur on February 22 to coincide with the College of Engineering Open House and National Engineers' Week. Two more Open Houses are scheduled: one in April to coincide with Parents' Weekend and one in October. In addition to these Open Houses that occur on the main campus of Virginia Tech, the Northern Virginia Graduate Center will be open for tours of Electrical Engineering in May.

Professor F.W. Stephenson, head of the Bradley Department of Electrical Engineering

Historical displays are planned for Engineers' Week in February and at the Donaldson Brown Center in April and September. The display will feature photographs and electrical items of significance to the Department as well as an original Edison light bulb.

A Film Festival is also planned for the Open House to be held in February. The films will tell the stories of important people in the history of electrical engineering including Maxwell, Edison, and Morse.

A History of Electrical Engineering at Virginia Tech

Electrical engineering began at Virginia Tech, then known as the Virginia Agricultural and Mechanical College, in 1891 with the formation of the Physics and Electrical Engineering Department. One lecture room and one laboratory were dedicated to the new department. Four courses were established; one was taught from a text titled *A Mathematical Theory of Electricity and Magnetism* by James Clerk Maxwell. The first degrees in electrical engineering from the college were awarded in 1894 to three graduates.

In 1893, John McBryde, president of the college, recruited Samuel Pritchard to be chair of physics and electrical engineering. Professor Pritchard remained department head of electrical engineering until 1935 and also acted as dean of engineering from 1918 to 1928. Professor Pritchard was known for using his personal funds to purchase laboratory equipment.

Another early founder of the department was Claudius Lee. He graduated from electrical engineering in 1896 and began a 50-year career working for the department. Professor Lee organized and taught many courses and laboratories and was regarded for his personal interaction with students. In addition to teaching, Professor Lee served the college as superintendent of the Electric Light Plant and by designing machinery, including a clock system that linked the college.

By 1905 enrollment in electrical engineering had grown considerably; there were 23 graduates in this year. Faculty consisted of Professors Pritchard and Lee and one other assistant. Also in 1905, the department's main building, Science Hall, was destroyed by fire. Damaged laboratory equipment was repaired by faculty members and Science Hall was quickly rebuilt. Repairing the damaged equipment was not a technical problem since most of it was built by the EE staff.

Professor Pritchard died in 1935. Professor W.A. Bailey took over as department head. Professor Bailey introduced electronics courses and laboratories into the curriculum for the first time.

World War Two greatly reduced enrollment, but the end of the war marked a large increase in student enrollment and faculty. Claudius Lee retired from teaching in 1947 but worked in his office in Patton Hall until his death in 1962. This era also saw the first female graduate in electrical engineering — Carman Venegas of the class of 1938.

Professor Murray stepped down as department head in 1956 but continued

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Heat Flux Gauge:

Researchers develop breakthrough at Virginia Tech

by Stephen Payne

Everyone is familiar with the thermometer, the simple device used to measure temperatures. When things get too hot, typical thermometers melt. In addition to this, typical thermometers are often not sensitive enough for certain applications. This is the impetus for the recent invention of a revolutionary heat flux gauge at Virginia Tech. Dr. Tom Diller, a professor in the Mechanical Engineering Department at Virginia Tech, and Dr. Shinzo Onishi, a professor in Electrical Engineering, hold a joint patent on the new invention.

This heat gauge is different than any other in that temperatures upwards of 600 degrees Celsius (over 1100 degrees Fahrenheit) have been measured successfully and accurately. Both Diller and Onishi have been working on the project together for about four years, Diller dealing mainly with the applications and theory involved with the device, and Onishi handling the design of the thin-film materials of the gauge.

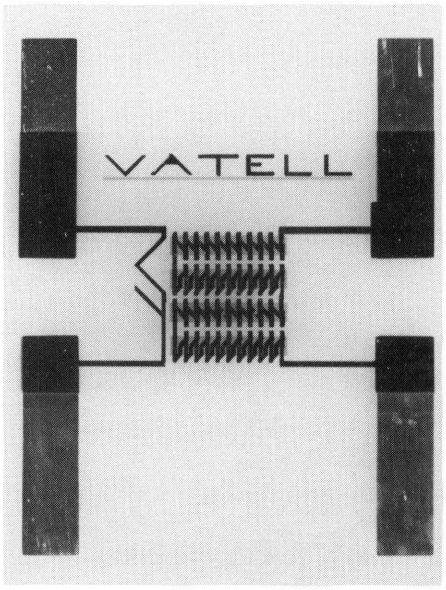
There are actually two different types of heat flux gauges. The first type is a gauge that is used primarily at low temperatures, like room temperature, but has a very high level of sensitivity. The other type of gauge is one in which accurate measurements can be obtained at extremely high temperatures.

The gauge itself has many unique properties, making it superior to and unlike any gauge before it. Its large temperature capability of 600 degrees Celsius goes far beyond the tolerance of any gauge before it. In addition, the gauge does not interfere with any measurements it takes, that is, the gauge's physical presence within the environment does not affect its operation, whereas normal heat flux gauges must be compensated for the manner in which they are installed.

In addition to being totally passive, the gauge also has a very fast response time (less than twenty microseconds), a direct linear output so that its functioning can easily be monitored on an oscilloscope or other instrument, and has a tremendous range of uses.

Grants and support have been provided for the project over the past few years. The National Science Foundation (NSF) has funded the research for about three years, and it is from this grant that the research was started. Other sponsors include NASA, the National Aerospace Plane (NASP), the Navy, the Air Force, the Vatell Corporation, and the National Institute Of Health (NIH).

Problems with the gauge now consist of getting it to consistently give high output and high reliability in whatever conditions it is operating. Especially at high temperatures, adhesion, or lack thereof, is a problem. In the particular case of the gauge being used on a metal surface, there



have been some problems in getting the gauge to stay fixed to the surface. Normal glues decompose at high temperatures, and interfere with the gauge's measurements, potentially causing errors in measurements of tens of degrees. Even the highest quality glues lack consistency.

Also, there is a need to develop a thin film gauge that will work on a curved surface. One perplexing problem was that of how to connect the gauge to work with current instrumentation; however, Diller says that "this problem has since been more or less solved, and that it is not much of a problem any longer."

Larry Langley, President of the Vatell Corporation, a Blacksburg firm, says that the instrument is now in the very early stages of marketing. Under the patent issued to Diller and Onishi in 1988 the Vatell Corporation is the exclusive licensee, by arrangement with the Virginia Tech Intellectual Properties group (VTIP), a group that handles inventions and patents of this nature done within the university. This patent thereby denies this technology to anyone else, and gives the holders of the patent the right to use the technology themselves, even though there are many parties interested in the gauge, like many of the major gas-turbine and rocket companies. Langley said that "this is a very typical situation for an idea of this type originating and being developed at a university." Due to copyright and licensing reasons, it is important for the exploiter to own or have rights to the product and its patent. This material license, obtained for the gauge's particular combination of materials, is good for twenty years.

"In developing this gauge, there are two different categories of uses for it," says Langley. "The first consists of simply using the gauge itself for use in airstream measurements, combustion chambers, and the like. The other use concerns the variety of applications now available due to the gauge's existence. Some of these applications are thermal conductivity and thermal diffusivity measurements, as well as the use in blood profusion measuring instrumentation and other medical applications. Either way you put it, each of these different types of uses could be big business."

Further research on the heat flux gauge include its testing in high speed combustion chambers, and in association with SCRAM-jet testing. So far, the gauge has lasted through tests in propane flames exceeding 1000 degrees Celsius, and in the Virginia Tech wind tunnel where velocities above 3.5 Mach were achieved. "Even so, there are always improvements to be made and always

See Gauge, page 10

"Mommy, Where Do Engineers Come From?"

by Anthony Giunta

Stop for a moment and think about the number of engineering students in the United States. Let's say there are about 20 universities that have engineering undergraduate programs that are comparable in size to what we have at Virginia Tech. Now add in a few thousand more from smaller schools and community colleges. In a roundabout way, we can estimate that there are around 125,000 engineering students in this country (no significant digits here). Whoa! Ouch! That means there are thousands of people out there all waiting to be hired for the engineering job you were certain to get just a few months ago. Where did all these people come from?

Ask a business major this question and he or she would say that the engineering student was probably dropped on his head shortly after birth. A psychology major would reply with a long discussion about Freud and the adverse effects of being potty trained too early. They would both be close, but they would still be missing the most important factor — toys!

Think back to when you were a child and you will probably find that something somewhere resembles engineering. Now I know what some of you are saying: "I liked dinosaurs; what about that?" or, "Barbie was my favorite when I was little." Well, I am not a psychologist so I cannot answer that one, except to say that you probably were not dropped directly on your head.

The first book I can remember is Richard Scarry's *Cars and Trucks and Things That Go.* It had pictures of cars, trains, boats, planes, and just about everything mechanically oriented. Then came the plastic models. There were some ships, and a few tanks, but the big thing was airplanes. It is no wonder that I ended up in aerospace engineering. From what I have heard from my AE friends, they experienced pretty much the same thing.

Acting on a hunch, I asked one of my roommates, who is an EE, what his toys were. You can probably guess that his answer was a Radio Shack "200 in 1" set. Then I looked at the mass of wires and chips on his desk that was supposedly a computer architecture project, and saw that he was still playing with it. In fact, he and one of his friends toyed around with lasers and holograms while they were in high school. If that does not turn a person into an engineer then nothing will.

From these not-so-scientific findings, an engineering student's childhood toys can be inferred from his or her major. You do not need to be a Nobel Prize laureate to guess that more that a few chemical engineers must have had the "Dr. Jekyll and Mr. Hyde Chemistry Set" or that future materials engineers loved their "Play-Doh Fun Factories."

A friend of mine said she spent hours building houses out of Lego blocks. I was not surprised to hear this because she is a CE major. Mechanical engineering is such a diverse field that a future ME could have played with any number of toys. Matchbox

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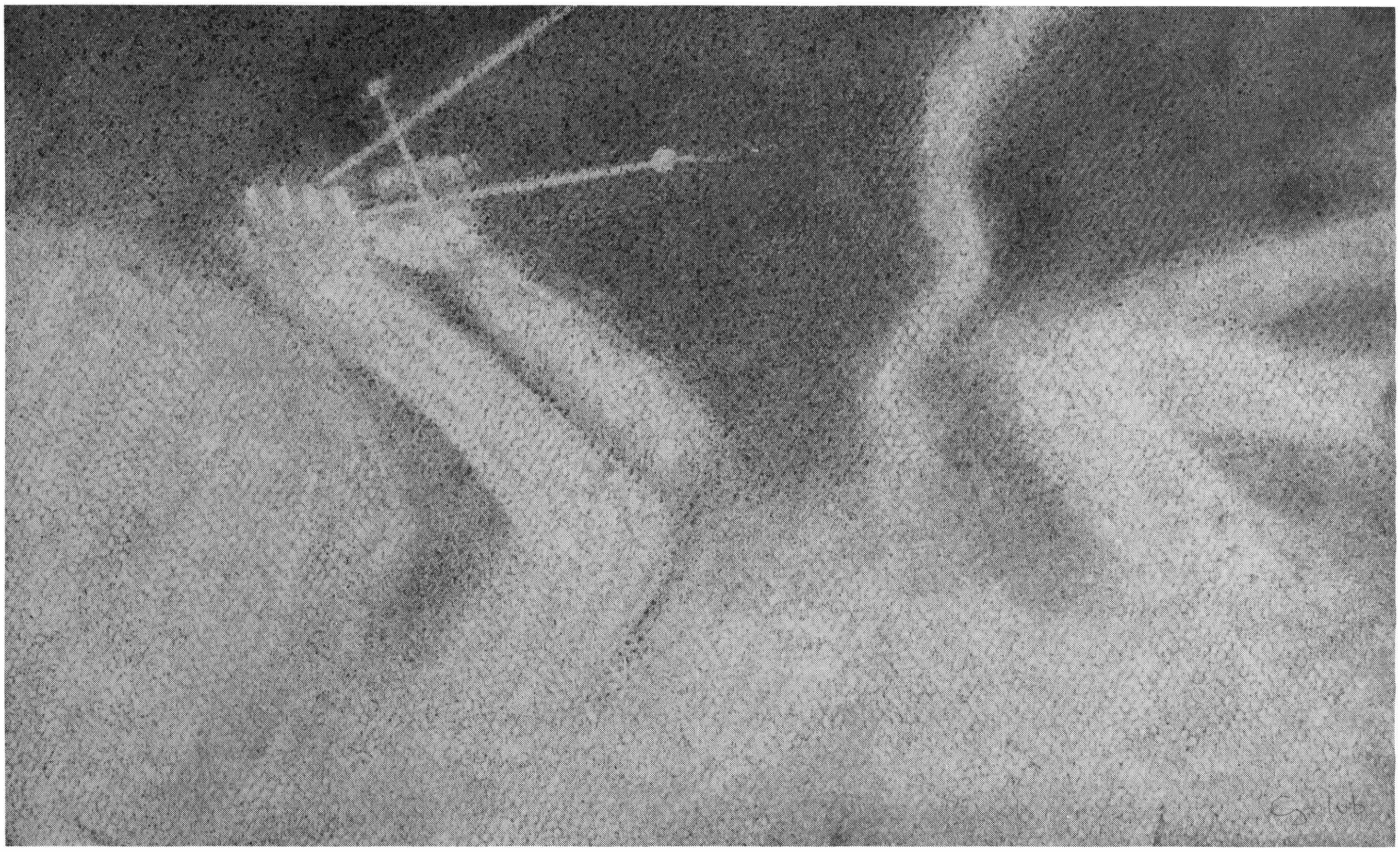

MERCEDES BENZ:
a lesson in quality

by Kendall E. Giles

German taxi drivers do it faster and longer than anyone else. They drive at what seems to be near Mach speeds along the Autobahn, maneuver through wispy cobblestone streets, and scale the lofty alps — day after day, rain, snow, or shine.

A breakdown of any sort would cost them dearly, both in getting their vehicle fixed and in losing wages. But taxi drivers are not known for their wealth as a look at any Washington D.C. taxi (most often a dilapidated 1971 station wagon or similar such vehicle) will confirm. Why then is the vehicle of choice for German taxi drivers the Mercedes-Benz?

The Mercedes Benz Manufacturing Plant in Stuttgart-Unterturkheim, Germany, a company that is a model of precision engineering and quality control, maintains a name synonymous with automotive reliability and durability. American automakers would do well to look, listen, and learn from our German neighbors, to receive inspiration and ideas for improvement upon the American car quality track record.

HISTORY

Karl Benz was born on November 25, 1844 in Karlsruhe, Germany, the son of an engine driver. Benz worked for a time as a draftsman but switched to working on the two-stroke engine for his livelihood. After laboring two years on his own design, he got his first engine to work. Immediately he founded "Benz & Co., Rheinische Gasmotorenfabrik" in 1883 in Mannheim, Germany producing industrial engines.

But Benz's dream was to design a "motor carriage" with an engine based on the Otto four-stroke cycle engine. On January 29, 1886 he was granted a patent on this vehicle designed exclusively for the engine and on July 3, 1886 Benz introduced to the public their first automobile.

Gottlieb Daimler was born on March 17, 1834 in Schorndorf, Germany, the son of a master baker. Daimler first worked for several engineering firms in France and England before becoming, in 1872, the Technical Director of the Gasmotorenfabrik Deutz AG, founded by Nikolas Otto and Eugen Langen. While he was there, Otto developed the four-stroke engine. Daimler became convinced that this smaller and lighter engine would prove superior to the larger gas engines common during that time period. He therefore worked on making the four-stroke engine smaller, lighter, and more efficient in order to increase its suitability for vehicular use.

By 1883 Daimler had taken out Patent Number 28022 on the first small, lightweight, high-speed combustion engine, and in 1890 founded the Daimler-Motoren-Gesellschaft in Cannstatt, today a part of Stuttgart. Daimler worked on improving the design and first tested the engine in a "riding car" (actually

Origin of the name MERCEDES

Emil Jellinek was a businessman who had developed a passionate interest in automobiles. In 1893, Jellinek travelled to Cannstatt and met Gottlieb Daimler. Over the next several years, Jellinek bought several of Daimler's vehicles.

In 1898, Jellinek bought a Daimler Phoenix, complete with a four-cylinder engine, which he drove in the Tour de Nice. At the time, it was fashionable to enter these automobile races under a pseudonym, so Emil Jellinek raced under the name of his third child, a daughter with a Spanish Christian name meaning "grace:" Mercedes.

On March 21, 1899, "Monsieur Mercedes" won the Tour de Nice, when his daughter was just nine and a half years old.

When the Daimler-Motoren-Gesellschaft improved on the car's design by enlarging the wheelbase, lowering the center of gravity, and increasing the engine power, Emil Jellinek put in an order for 36 cars, worth 550,000 gold marks. His order was made with two conditions: first, he must be made the sole car agent in Austria-Hungary, France, and America. Second, the vehicles must be named after his daughter Mercedes.

The name proved to be so popular that the Daimler-Motoren-Gesellschaft used it for all its cars and in 1902 a trademark was taken out for the name.

And the rest is Mercedes history.

the first motorcycle). One year later the engine was placed in a boat and finally, in 1886, it was placed in a carriage.

Unlike Karl Benz, Daimler did not place a lot of emphasis on the vehicle design but was more interested in the development of a universal form of propulsion which could be used for travel by land, air, and water.

The famous three-pointed star has been the company's symbol ever since 1909, representing Daimler's three areas where his engine could operate — on the land, in the air, and at sea.

Both companies flourished, finding applications for engines in passenger cars, sports cars, "self-propelled" fire engines (1906), busses (1895), trucks (1896), large ships (early 1900s), and aircraft (1909, after the Wright Brothers flew in "heavier than air" machines in 1903).

The market became very competitive, and so in 1924, Daimler-Motoren-Gellschaft and Benz & Co. formed a loose association of common interest. The two companies merged in 1926, and thereafter all the products of Daimler-Benz AG bore the dual name "Mercedes-Benz."

In 1902, the trademark "Mercedes" had been registered for the products of Daimler-Motoren-Gesellschaft and the three-pointed star was added in 1911. The laurel wreath from the Benz emblem was used in the Mercedes-Benz emblem and today remains unchanged. Likewise, the goal at all the Mercedes-Benz factories of fitting the needs of the market with a high-quality standard remains to this day.

MERCEDES-BENZ MANUFACTURING

The Mercedes-Benz division is one part of the Daimler-Benz Group, the other components being the AEG Division (office and communication systems, automation systems, electro-technical systems and components, consumer products, microelectronics, and transportation systems — similar to our General Electric) and the Deutche Aerospace Division (aviation, space, defense, and medical systems).

In 1989, the Daimler-Benz Group had some 368,226 employees worldwide. The Mercedes-Benz Division had 223,219 employees and captured 31,865 millions of Deutsche Marks (DMs) in passenger vehicle and 23,104 millions of DM in commercial vehicle sales out of a total of 76,392 millions of DM for the Daimler-Benz Group as a whole.

KUDOS IN UNTERTURKHEIM/STUTTGART

The large success of the Mercedes-Benz Division is due to its willingness to invest money in research and development, both in better product design and in better process development. The main

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Mercedes

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manufacturing plant in Unterturkheim/ Stuttgart showcases some of the technologies with which Mercedes-Benz has achieved its position of excellence.

The production process is highly automated, utilizing robots and computers to increase efficiency and decrease overhead and errors in quality. For example, robots are used in deburring sand cores — once a tedious and slow process by hand, and in forging and tempering metals — once a hot and slow process by hand.

Also, industrial robot welders greatly optimize a once-difficult chore. Optical sensors guide the path of the weld and detect any out-of-limit flaws, resulting in an immediate shutdown of the line so that the error can be corrected as soon as possible with a minimum loss of time. The use of these weld guidance sensors also reduces quality control check costs.

But "the robot is never the standard answer to every problem," says Herr I.V. Hammer of the Division of Personnel. "Humans are used periodically in the engine manufacturing line to give visual inspection checks."

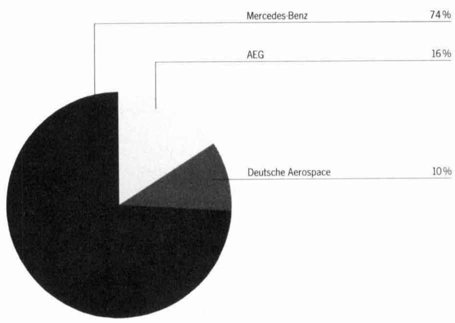
This element of quality control is one reason why Mercedes-Benz equipment is so dependable. Most manufacturing plants have some form of "Quality Control" department whose sole purpose is to be the eye of the needle through which all parts must pass. This often causes delays; inspection is a slow process. Mercedes-Benz eliminated this department entirely. Says Hammer, "Quality Control is now a full part of the product process, not a separate department."

If an error is detected anywhere in the production line, the machine stops itself, and the floor manager is immediately alerted to the exact location and nature of the problem. But errors are relatively rare. "Quality cannot be controlled out — it is achieved by design," says Hammer. By starting from square one with a correct design, fewer problems are encountered down the road. Also, since Quality is inspected for at every stage in the production line, an error detected early on is corrected quickly (and therefore at less cost) than by waiting until the final once-over by the Quality Control Department.

SIMPLICITY OF DESIGN

A second reason for the Mercedes-Benz success comes from the simplicity of the engine designs. For the passenger car engine, there are only 19 basic designs. From these, Mercedes-Benz makes simple modifications to each one, resulting in 4500 versions, and jumping to 6000-7000 versions in the next two years. With just a few modifications you can get many different models of cars.

Purchasing Volume of the Daimler-Benz Group
DM 45 million (1988: DM 43 million)



The production-line robots which assemble the engines are lined up in a series of substations. They read the engine type and requirements from a magnetic card. The robots assemble the engine without requiring an operator to change the assembly machinery and tools every time a new engine comes through.

This allows Mercedes-Benz to produce engines of different types as needed without having to stockpile engines made in production runs. For example, start with one particular four-cylinder, two-liter engine. By adding a cylinder, you have a five-cylinder, 2.5-liter engine. Add another cylinder and you have a six-cylinder, 3.0-liter engine. This gives three engines based on one design — and all can be handled easily by the production-line robots.

Mercedes-Benz serves the United States with two engine designs. One covers 49 states; a different one is needed to meet California's tougher emission laws. This disparity is tolerated because 53% of the exports are to the U.S., Mercedes-Benz's number one customer. Japan ranks number two with an ever-increasing 40% of the market.

This flexibility of many engine variations is very interesting when compared to the Japanese auto makers. The Japanese produce three cars for every one that Mercedes-Benz produces. However, Mercedes-Benz is selling more cars in Japan than Toyota is in Germany, and is making more of a profit; it takes four to five Japanese cars to equal the cost of one German Mercedes.

ERROR-FREE ENGINE TEST FACILITY

The Mercedes-Benz Test Engine Facility is the first completely computerized system. The engines proceed without human intervention through a series of test-chambers where "every single component of the system is checked and the data is stored," says Hammer.

All functional data about any engine can be obtained in two minutes. Likewise, information about the functional data of the entire car is stored. This is important not only in the quality sense but also as evidence against liability suits. Says Hammer, "If a complaint comes in ten years later, say a wheel comes off somebody's car, we can prove that the wheel was properly fitted here and is not our fault" by consulting the information stored on the card.

He stressed, however, that Mercedes-Benz does not invest so much money on research and development just to meet safety standards and to protect against liability suits — they do it to make a better car. He added that production costs would be cut 75% if Mercedes-Benz met only the minimum legal requirements.

ATTENTION TO THE WORKERS

A third reason why Mercedes-Benz heads the automotive quality pack is due to the attention that the company pays to its workers. Such attention is given because, says Hammer, "An unsatisfied worker won't produce quality."

85% of their work force is highly-skilled labor. This calls for higher wages and other benefits, such as duty rotations and six weeks of vacation per year. Also, Mercedes-Benz spends $250 million per year training workers to handle new designs and manufacturing techniques. Workers are trained on a new engine six to 12 months in advance of actual production, to familiarize them with new tasks. As additional proof of their devotion to the employee, says Hammer, "Since 1949 we haven't laid-off a single worker."

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The Environment and Modern Society

by Mike Reese

Amid all the technological advances our industrial society has brought, new emphasis has been shifted to the environmental problems these advances create. The field dealing with this research is a branch of Civil Engineering called Environmental Engineering.

The world is in need of people who are willing to make our planet a healthier and more stable place. At Virginia Tech, the students in Environmental Engineering are doing just that. Research ranges from the clean-up of contaminated sites to the treatment of toxins.

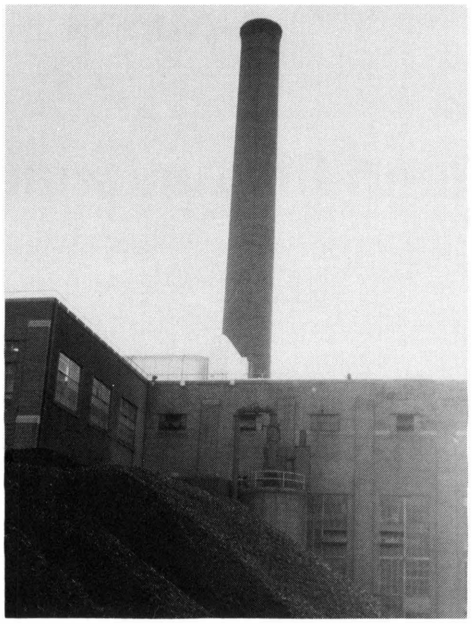
Although the Environmental Engineering program at Virginia Tech is well-respected in the country, many students here are not well-acquainted with it. This may have to do with the fact that a degree may only be received through graduate school.

Dr. Bill Novak, Prillaman Professor of Civil Engineering, commented, "We have a large staff..., good laboratory analytical equipment, students who are interested in their research, and many calls to hire our students from different companies." Dr. Knocke, Lunsford Professor of Civil Engineering, added, "Our program is in the top ten in the country right now."

Research being done at Virginia Tech by Environmental Engineering students deals mainly with the treatment and clean-up of environmental problems. An example of this clean-up is in the use of surfactants. Surfactants are natural polymers which help to move pollutants through soil to sites where the pollutants can be broken down into non-hazardous waste. The cleaning up of sites is another problem students are fighting.

Research done by Environmental Engineering affects our everyday life in areas we generally take for granted. The faculty at Virginia Tech has made a considerable contribution to aiding in the relief of different problems. Dr. Novak was asked by a local company in Roanoke to help with the problem of fly ash. Fly ash, an ingredient of cement, is a pollutant that is hazardous when it "flies;" so Dr. Novak came up with a way to solidify the fly ash in cement.

And, tons of tires that were dumped into large piles decades ago are now potential environmental problems. Dr. Hughes, an associate professor, is doing work on a means to pulverize the tires into small pieces and then burn them in furnaces along with coal. His tests deal with the effects of burning the tires and the resulting impact on air pollution.



"The problems will be with us as long as there is industry, so the need for students will be endless."

Dr. Knocke has recently done research on a subject that most people usually don't come in contact with on a regular basis: residue management of sludge characterization. Sludge is the combination of excrements and other wastes that come through sewage pipes to treatment plants. Testing was done in the handling of sludge — finding new ways to develop waste precipitation, and even to extract products out of sludge.

Dr. Knocke said that the only changes that need to be addressed in the Environmental Engineering is the expansion of the program. "We are tight in facilities and lab equipment; we do have the potential for more students." An undergraduate degree is not foreseen in the future due to the need to hire more faculty and to provide more lab space. And, with the crunch the college is now under, the possibility for expansion is slim.

In the years to come, research might focus on new materials to be used in our surroundings. New materials must be developed to substitute for older chemicals and compounds which have been discovered to be hazardous.

Another area for future research is in the containment of waste which cannot be broken down to safe levels. This research would also involve other areas of engineering. The problem with toxic chemical waste is that it takes many years to break down. New materials are needed which will hold these toxins for a great number of years without leaking. This is important because any damage to the containers could potentially cause a catastrophe. Clean-up could take years, resulting in a great amount of loss in productivity and in funds.

The next step up in containing the pollutants is the development of liners on the dump sites. Geometricians are a form of liners being developed to contain any leaks which could occur from a primary source. Geometricians for use in lining trash pits — and storage facilities to contain areas — are just some of the new materials needed to help solve our ever-growing environmental problems.

New materials will have to be researched for a different varieties of problems. The problems will be with us as long as there is industry, so the need for students will be endless.

The world is a changing place. This will lead to new branches in Environmental Engineering, and the need for other students to pursue new environment concerns in their own field. Engineers will be continually driven to develop new and better ways to deal with the problems man has and will fabricate. Our students are busy improving and correcting our surrounding environment to make our Earth a healthier and better place to live.

SEC News

by Timothy Baker

1991 has arrived and there are many activities and events just around the corner including the following:

Engineers' Week will be held February 17 through February 23, 1991. Detailed calenders will be available soon which include information on the SEC Olympics, the Engineering Semi-formal dance, Open House, Lab Tours, Engineers' Choice, many interesting speakers, a student/faculty luncheon, other engineering society-sponsored events, and an E-week social/awards ceremony.

Student Engineers' Council

The annual Sporn Award and Paul Torgersen Scholarship recipients will be announced at the student/faculty luncheon. Please take time to come out and enjoy E-week!

Nominations for next years office will be taken on February 27 at the general meeting. Elections will then be held at the general meeting on March 6. If you are interested in holding an office please see a current SEC officer.

Tech students attend the national SEC conference

by Cindy Tyndall

Early in the morning on November 2, two SEC members and three officers departed from Virginia Tech. Their destination: North Carolina State University (NCSU) in Raleigh, North Carolina, to attend the annual National Engineering Student Council Conference. The conference was hosted this year by the NCSU Engineers' Council.

The conference began with two speakers, Dr. Earl MacCormac and Dr. Fred De Jarnette. The afternoon was filled with plant tours of local businesses such as Northern Telecom, IBM and NCSU Precision Engineering Center. The evening was free to explore Raleigh, or catch up on some much-needed rest.

Saturday was filled with meetings as we started to attend to the business of the national conference. Ideas were exchanged and district ties were reviewed. We adjourned to a North Carolina Pig Pickin' and dance, bringing an exciting weekend to a close.

The Student Engineers' Council is a student run non-profit organization. Our goal is to help the engineering professional societies and honor societies coordinate their efforts for the betterment of the College of Engineering.

Each professional society may have two voting representatives and each honor society may have one voting representative. We encourage you to find a society that will enhance your engineering careers.

We also welcome members at large. Our meeting times are posted in Norris tunnel and our phone number is 231-6036. If you have any questions about the SEC, other societies, or concerns within the College of Engineering give us a call. We are here to help you!

Gauge

Continued from page 4

improvements to be made and always something to be done." said Onishi.

A barrier for the designers to overcome is the design of the manufacturing process of the gauge. Traditional integral circuit fabrication methods are difficult to use here due to the nature of the heat flux gauge. For instance, the manufacture of each gauge must take place entirely in a vacuum and takes about a week from start to finish. Also, the gauge itself is approximately five microns thick, or about ten times smaller than the width of a human hair. Langley holds that "presently, each gauge costs about $5000 to make, but ultimately, with a 5:1 reduction in cost still to achieve, the gauge should run for somewhere around $2000. Still, this is only as long as the manufacturing cost remains small enough in order that a profit can be made." he said.

Of interest to many now is the possibility of getting a new manufacturing facility on-line. "Once the gauges are able to be mass produced," said Diller, "the price of the gauges will hopefully go down quite a bit."

Nowadays, people want to see the thing be put to real use. So far, the gauge has primarily been used only in small devices in the laboratory. Even though its performance here has been impressive, results need to be seen on devices in the field so that the heat flux gauge's true capabilities can be effectively demonstrated.

Diller was quick to point out that most of the problems have worked themselves out, and the assumptions they made in designing the gauge were largely valid. When the work on the gauge began it was not known how things would turn out. As it happened, however, things worked out well and the gauge has been a tremendous success.

This innovation is very near completion and is a short distance away from being marketed. Before it can be allowed for use, further extensive tests must be performed. Even so, Diller and Onishi have made quite a breakthrough. The literal hundreds of applications of this tiny non-interfering heat flux gauge are simply astonishing. It will be quite interesting to see the effectiveness of this gauge, once it is integrated into use in society, hopefully in the near future.

***Steve Payne** is a senior in Mechanical Engineering who spends much of his time in the ME temple — Randolph Hall.*

Toys Continued from page 5

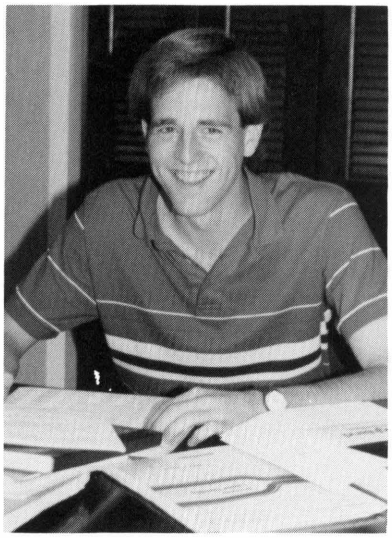
cars and erector sets probably were in almost any ME's toybox. Along with these playthings, an engineering student now taking the biomedical option would have had one of those clear plastic models that revealed the bones and organs in the human body.

Four- and five-year-old ocean engineers most likely spent quite a bit of time in the tub playing with plastic tugboats while their AgE friends were playing outside with miniature John Deere tractors. Meanwhile, the future mining engineer was in the backyard with a shovel and large mound of dirt, digging his way to China.

What about ESM and industrial engineering? Well, this one is a little tough to answer. The most popular theory on the development of ESM students is that they had just too many of the different kinds of toys. Because of that, they cannot decide on one single discipline and instead dabble in several fields at once. ISE majors present even more of a puzzle. Although studies are still being conducted in this area, scientists believe that either the children's mothers read too many copies of *The Wall Street Journal* during pregnancy, or that the ISE babies were dropped on their heads more than once.

If there are over 100,000 engineering students in just one four-year block, think about that number extended over several decades. Now you have, in the words of Carl Sagan, "billions and billions" of tiny Lego blocks and enough erector sets to build a pontoon bridge across the Atlantic. That is a large number of toys producing quite a few engineers. So, when you are in your mid-thirties and are buying toys for your own children, take time to think this over. Remember all those late nights, caffeinated beverages, and stress-induced dreams of thermodynamics. Then put the Radio Shack "2 million in 1" electronics set and the Milton Bradley "Home Fission Reactor" set back on the shelf and instead pick up a soccer ball and a book of Shakespearean sonnets.

***Tony Giunta** is a co-op student, so we suspect his parents used to pay him to build all those model airplanes. This semester, NASA is paying Tony to go play with them.*

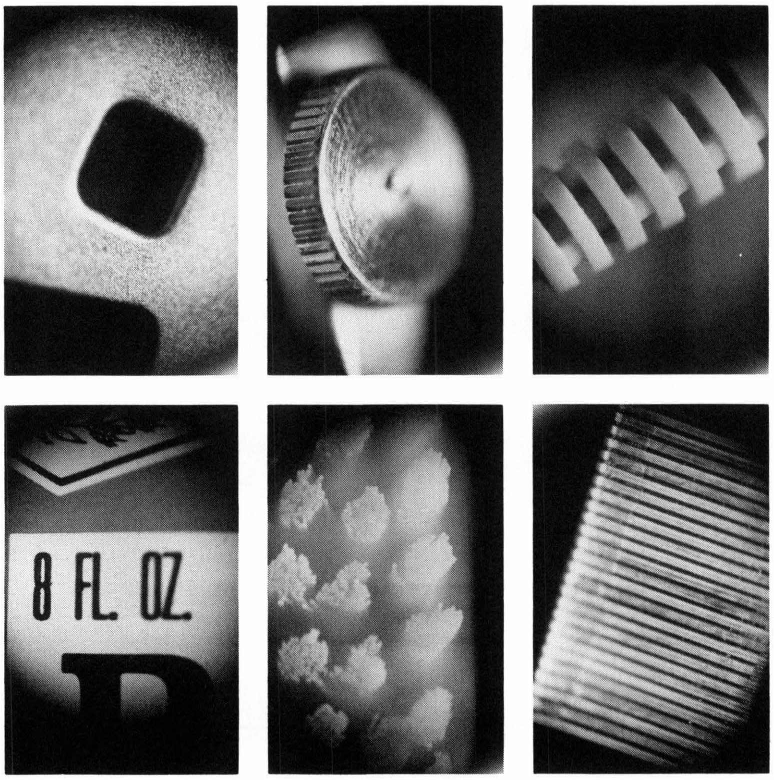


FORUM FOCUS

Howard Kash is business manager for *Engineers' Forum. He is a former EE geek who recently saw the light and switched to Computer Science. He is seen here calculating the money he will make in selling back his engineering texts.*

PICTURE QUIZ

Here are some common objects shown in an uncommon light. Can you recognize these images?



History *Continued from page 8*

to teach until his retirement in 1960. Professor B.M. Widener became the new department head but died shortly thereafter in 1958. Professor George Powley then assumed the role until 1964.

Professor Powley supervised major changes in the EE curriculum. The senior elective program was initiated requiring 29 quarter hours of technical electives. Previously, seniors chose between two programs: power or communications. The graduate program was expanded with the first Ph.D. candidate enrolling in 1963.

1966 marked the beginning of William Blackwell's 15-year term as department head. Many of the department's research labs that exist today were organized during Professor Blackwell's tenure.

In 1972 Professors Bostian and Stutzman received the first research grant for electromagnetics that later led to the formation of the Satellite Communications Group. Photovoltaics research was organized in the late 70s by Professor Burton. Professor R.O. Claus began work in applied optics that has led to the present day Fiber and Electro-Optics Research Center.

Today's Virginia Power Electronics Center has its roots in the Power Electronics Laboratory developed by Professor F. Lee in 1977. Hybrid Microelectronics research began in 1978 with Professor F.W. Stephenson. Professor R.M. Haralick began development of the Spatial Data Analysis Laboratory in 1979.

Professor Daniel Hodge took over as department head when Professor Blackwell resigned in 1981. In 1985 Whittemore Hall was completed as it stands today. In 1986 the Computer Engineering degree was offered for the first time.

A generous endowment of $5 million was made to the Department in 1987 by Mrs. Marion Bradley Via in honor of her father, Harry Lynde Bradley. Harry Bradley was a co-founder of the Allen-Bradley Company. The department's name was changed to the Harry Lynde Bradley Department of Electrical Engineering in recognition of Mrs. Via's donation.

Today's department head is Professor F.W. Stephenson. Professor Stephenson follows Professor H. VanLandingham who served after Professor Hodge resigned in 1989. Enrollment today includes around 1000 undergraduates and 270 on campus graduate students. Faculty numbers 59 and annual externally-funded research exceeds $5 million.

Reference: *A Chronological History of the Harry Lynde Bradley Department of Electrical Engineering,* edited by Robin Rogers.

Mercedes

Continued from page 8

Mercedes-Benz takes care of its people and, as a result, its workers are very dedicated, loyal, and determined to make a Mercedes-Benz the best car money can buy. And it shows.

With a life expectancy of the Benz passenger cars ranging from 130,000 to 200,000 miles, no wonder German taxi drivers own these vehicles. Mercedes-Benz cars are not cheap, but in terms of quality, durability, reliability, style, and comfort you get what you pay for. And these German cars, produced by an up-to-date and quality-conscious automotive company, are worth every dollar and Deutsche Mark.

THE FUTURE'S SO BRIGHT...

The future looks good for Mercedes-Benz. With a commitment to increased innovation and quality based on a proven track record, this company will continue to supply the world with classy and dependable cars.

But not everything is done for profit here. By 1993 Mercedes-Benz may introduce a sports car based on its racing car. This automobile will have a V12 engine with an output of 550-600 Hp — not the most fuel-efficient car, but definitely fun to drive. 500,000 DM will be charged just to cover production and development costs, not to make mega profit. This 6-liter V12 engine may also be used in trucks.

But for Mercedes-Benz, with its commitment to quality, no matter what kind of car it produces, the company will only encounter the same difficulty it faces now. Concludes Hammer, "The problem will not be to sell enough but to produce enough."

AMSE Notes

by Cheryl Pascoe

The American Society of Mechanical Engineers is the professional student group for mechanical engineering students. ASME's main objective is to bring students into contact with industry through tours and speakers.

Last fall we sponsored tours to the power dam on Smith Mountain Lake and to Industrial Drives in Radford. We sponsored a talk by placement services on resumes and held a mock interview session. And, we are organizing pizza luncheons with speakers from companies that are interviewing on campus.

Tech's chapter is a standout in our region of 13 schools from Virginia, North Carolina, South Carolina, and Tennessee. We are successful in activities, membership (391 last year), and fund-raising. We offer a variety of activities necessary to meet the needs of our diverse student section.

Our office is located in 100-N1 Randolph. Information about our activities is posted in Randolph lobby or is available in the ASME office. For more details, call at 961-2832.

PICTURE QUIZ ANSWERS: 1. Center metal hub on a 3½" disk; 2. Adjustment wheel on a compass; 3. Headphone jack; 4. Part of a beer can label; 5. A toothbrush; 6. A row of staples.

Cindy Mouton keeps looking for trouble.

As a new member of GE's Field Engineering Program, Cindy Mouton trouble-shoots equipment in some pretty wild places. Like the day she spent dangling six stories above the Mississippi River, trying to fix a crane.

Cindy's also gone trouble-shooting at chemical plants, paper mills and steel mills. She's been called on to repair everything from a vintage 1930's motor to the newest programmable controllers.

Field Engineering is not a job for the timid. You need the confidence—and broad-based knowledge—to walk day after day into new situations where you face the unknown.

If, like Cindy, you've got a sense of adventure, then Field Engineering could be the field for you.

In fact, if you're gutsy, outgoing, and capable, GE has opportunities for you no matter what field you're in.

So while you're out there looking around, take a good look at GE.

GE

World of opportunity.

An equal opportunity employer.