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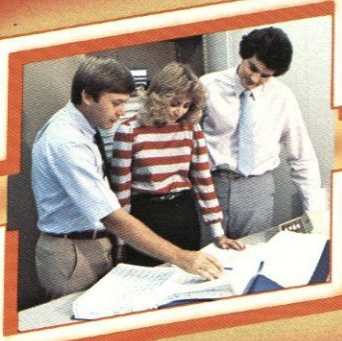

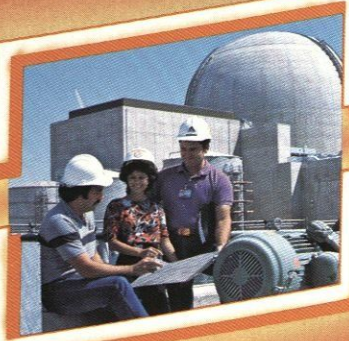

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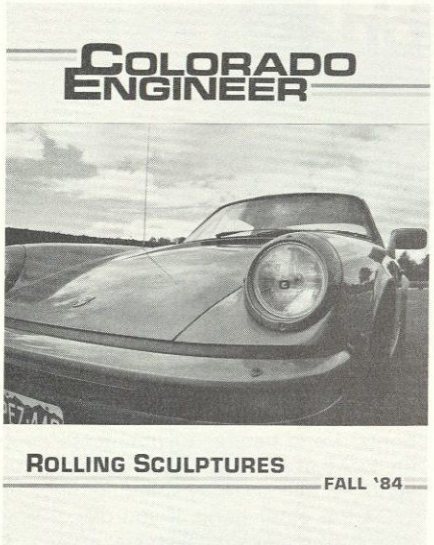

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FEATURES

DEPARTMENTS

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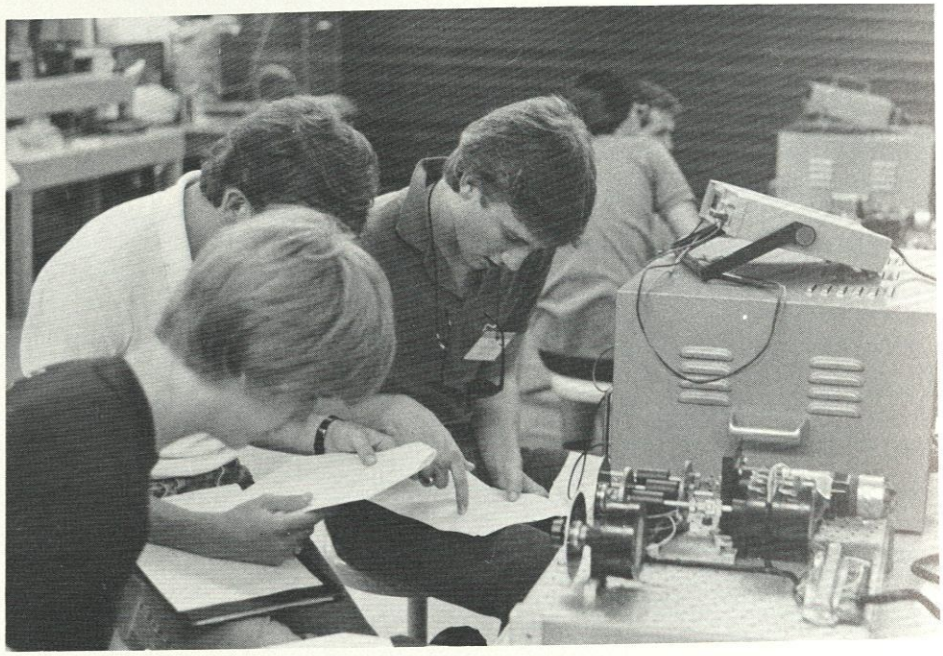
NEWS

CU HONORS INSTITUTE A SUCCESS

From August nineteenth to the twenty-second, the University of Colorado College of Engineering and Applied Science hosted the Seventeenth Annual High School Honors Institute. The Institute provided a chance for high school students between their junior and senior years to visit the University and experience dormitory life, lectures, and laboratories just like full-time engineering students. The Institute offered several different curriculums which corresponded to the engineering majors of electrical, mechanical and civil, aerospace, and chemical and biosciences, and a program combining all the engineering majors.

The Institute was conducted on a complex and tight schedule organized through the office of Dean Maler and supervised by Mrs. Margaret Ryan. The 381 participating high school students were assisted by thirty-nine group leaders, all of whom were engineering student volunteers, as well as thirty-nine representatives from companies that support the College of Engineering.

"The whole thing was a success, and I think everyone had a great time," commented one group leader whose sentiments were echoed by virtually everyone involved. Every participant in the Institute was given the privilege of seeing Professor A.A. Bartlett's presentation on Exponential Growth and Vance Brand's account of his Space Shuttle missions. The students were also treated to one evening each at the CU Recreation Center and Fiske Planetarium.



High school students learn to use EE lab equipment.

ENGINEER'S MEDIAN SALARY TOPS $43,000

According to a recently released **NSPE Professional Engineers Income and Salary Survey,** the median income earned from primary employers by National Society of Professional Engineers (NSPE) members reached $43,017 in January of 1984. This represents a gain of 4.2 percent in the twelve-month period since the preceding survey, barely more than the 4.1 percent increase in the Consumer Price Index during the same period.

Top salaries were reported in the western region, including Alaska, Hawaii, Montana, Idaho, Washington, Oregon, California, Nevada, Arizona, Utah, and Guam, where the median of $45,511. This narrowly edged out the northeast's median of $45,400.

New York City was the leader among major metropolitan areas with a median of $51,300, followed by Houston at $50,608, Newark/Jersey City at $50,000, and Los Angeles/Long Beach/San Diego at $49,900. Cincinnati ($37,107), Cleveland ($41,696), and Kansas City ($41,760) posted the lowest medians.

Despite a drop of almost $1,500 from the previous year, petroleum and mining engineers again reported the highest median among engineering disciplines, at $51,059. A distant second were nuclear engineers at $47,640, followed by chemical engineers at $47,000.

By industry, petroleum and coal products continued to lead with a median salary of $50,675, followed by pipeline utilities at $47,950, and chemical, pharmaceutical and allied products, and communications services at $47,000. Lowest-paying employers continue to be the three levels of government—federal, state, and local—at mediums of $40,869, $37,000, and $37,681, respectively.

By degree level, the median for engineers with a BS in engineering was $41,756. Those with an MS in engineering reported $45,000 and those with a doctorate, $52,000.

By length of experience, medians ranged from $26,000 at the under-one-year level to $52,000 for those with 30 or more years of experience.

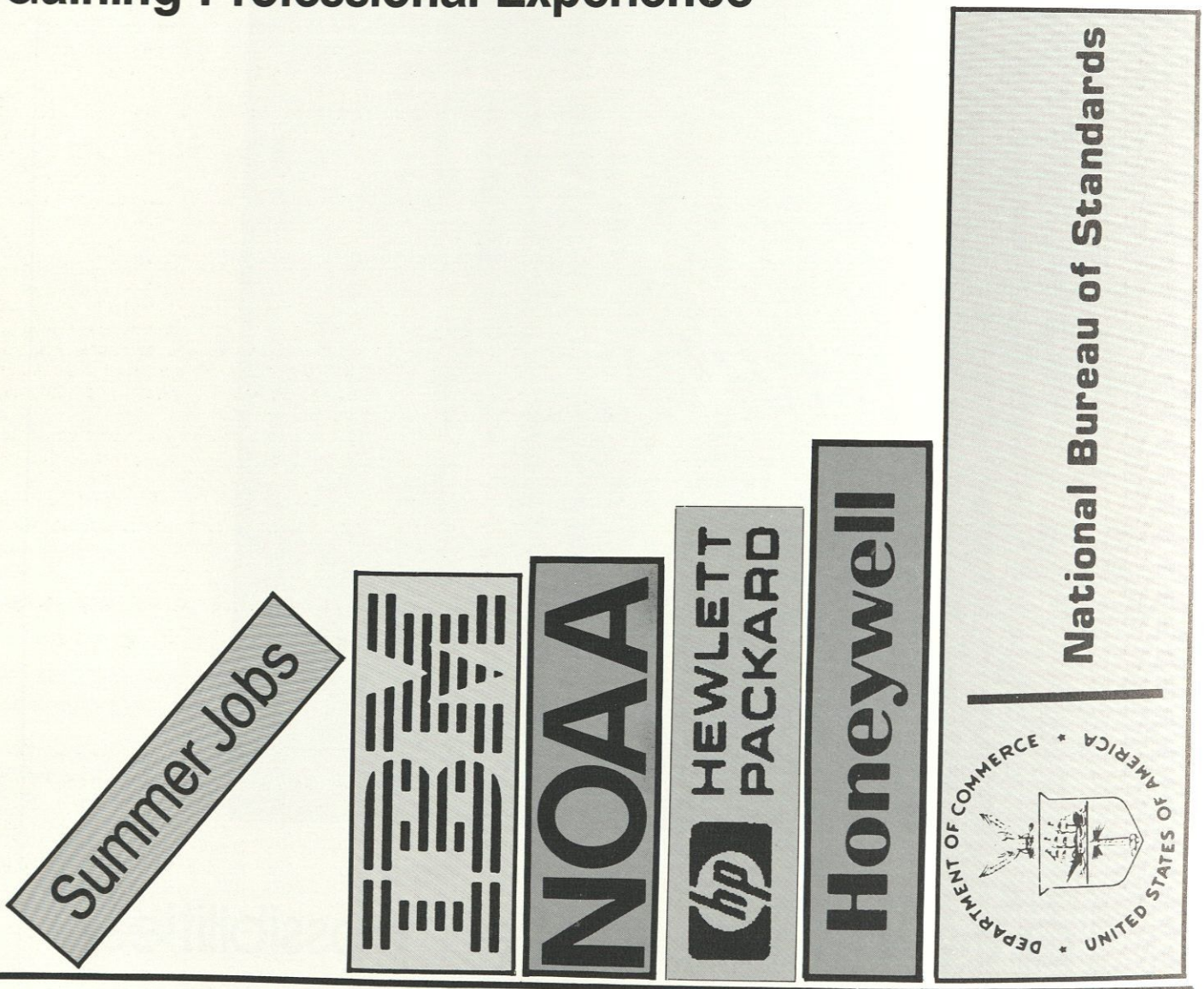
Highest-paying job function continued to be the executive/administrative category, with a reported median of $51,000, followed by sales/marketing at $43,484, and teaching at $40,000. Design engineers mostly a younger age group, reported the lowest incomes at $37,500.

The survey is based on a questionnaire mailed to 62,371 non-student, actively employed NSPE members in January 1984. The results are based on 16,000 returns. Income is defined in the survey as the individual's annual base salary from the primary employer as of January 1, 1984, plus fees, bonuses, and commissions, during the preceding twelve-month period.

NEW FLUIDS LAB EQUIPMENT

Professor Patrick Weidman of the Department of Mechanical Engineering at the University of Colorado, Boulder recently received an equipment donation from Esterline Angus Instrument Corporation. The donation included a model XY575 recorder and an event recorder.

Gaining Professional Experience



Summer is finally(?) over. Once again, you are faced with the problem of paying for another semester of school (differential tuition — just what you needed.). So here you sit, comparing your summer earnings to your roommate's. Why is it that she got paid so much more for three months of work? And what is all this talk of resumes and references? Boy has she changed!! What can you do now to avoid another summer of mindless labor? This article uncovers various engineering-related summer jobs found by students, as well as the methods used to locate them.

Greenskeeper No More

by Brian Heble

I suppose we all have had personal experience with the ill-fated "summer jobs" of years past—slinging the Mcburgers, stocking shelves 'til 3 am, waiting on "pleasant" customers. Yours truly is no exception. My niche for the past five summers was as one of many college students playing greenskeeper at a local golfcourse.

At the beginning of summer it was always great seeing the guys again, playing basketball at lunch, taking the infamous "short tour" at Coors after work, and enjoying the weekly softball free-for-alls with other crews. When we worked, the job itself was rather unchallenging (other than trying to mow a straight line at 5:30 am), but it was always waiting there after a long haul at the books.

Starting into my junior year, though, I decided there had to be better paying jobs and some challenging hands-on experience that would justify my past two years of mass, energy, and momentum balances. That's when the big push for the "real" summer job started.

Well the data sheets were typed up and sent, probably 13 in all, and slowly but consistently the "on file" and "rejection" letters trickled in. One evening during spring break, with my mind wandering into the realm of swarming killer-caddies with swinging 9-irons, Dad awoke me in his own parental sense of humor with the news, "Somebody from San Jose wants to sell you a computer." That "somebody" just happened to be from IBM and would soon be my boss for the summer. After hanging up the phone, I don't remember sleeping that night.

That "somebody" just happened to be from IBM and would soon be my boss.

A California summer! The thought really took some getting used to. I'd never really spent any time on the west coast, much less anywhere else other then good 'ole Westminster, Colorado, during the past few years. My roommate immediately put together a tentative sight-seeing list for me to follow on the weekends. (He never has said so, but one got the feeling he thought the engineering type a bit narrow-minded or even boring.) It was tough concentrating through finals, but soon enough, I was bouncing along in a VW trying to find, ". . . the way to San Jose."

The first few weeks in any new work and living environment is always challenging. About 14,000 people work at the IBM General Products Division in San Jose. Combine that with working for the leader in today's fastest growing technology and you get a pretty humbling experience for a senior in college.

The site primarily manufactures head-disk assemblies (HDAs) for the large mainframe computers. Research in these areas is also coordinated at the San Jose plant. I was assigned to the Chemical Planning and Control Department, which had been formed out of several independant departments less than a week before my arrival. It turned out to be a great opportunity to observe a manager in action molding strong and effective teamwork from such a diverse background of expertise. Unfortunately, this reorganization affected my "summer project" orientation for a few days as several people prioritized my objectives for the summer differently.

Mom was having nightmares hearing about my living arrangements. The first house I stayed in turned out to be a real live chapter in one of your favorite daytime soap operas. Mother and daughter were often seen pulling at each other's hair, throwing plates, kicking in doors, etc. That living arrangement did not last long. However, the ordeal that tried my sanity the most turned out to be the necktie that needed tying every morning.

It did not take long to get my project on track as my manager was very generous to us "supplementals" with her time and went out of her way to handle any problems. The project was to design and implement a chemical tracking system in a relatively new IBM language and generate reports on the usage of chemicals on various locations on the plantsite. It would hopefully eliminate much of the paperwork used in tracking shipments of "virgin" and waste chemicals.

Santa Clara County has recently revised its laws to provide one of the toughest chemical storage and usage ordinances in the country. It requires businesses to keep track of all virgin chemical deliveries in bulk, drum, or cylinder form and all waste shipments to be reclaimed or disposed by vendors. It amounts to quite a lot of data. The final catch was that the program had to be user friendly (the check sequences were starting to add up already).

After spending a week or so studying a new language ("AS" for you IBMers), the pieces to this huge "summer project" puzzle were starting to get more and more numerous as my superiors were realizing just how powerful the language was. AS (Application System) is a "4th" level data management language that provides many capabilities for menu-driven networks, graphics displays, default report generation systems with override capabilities, etc. It was available at terminal locations all over the plantsite, so there was the added luxury of not having a permanent desk with a phone to guard. Inevitably, I also ended up meeting some very friendly people in User Support. They helped eliminate that engrained image of the devout computer hacker spending Friday and Saturday nights at the CC.

The rest of the summer was spent designing, testing, and fitting various routines into the menu-driven system. When I thought all the bugs were found, our local secretary would try out the system, looking for anything I might have missed.

It became apparent how important it is to enjoy your work.

After putting in a solid workday, I couldn't wait to get off and enjoy the life of a bachelor. Right at 3:42 I was nowhere to be seen. As the summer progressed, the hours and pay were overshadowed by my desire to succeed with my assignment. The overtime was building up ($$$), but more importantly, I wanted my first mark on the industrial world to be a positive one. It really became apparent how important it is to enjoy your work, and not because of the salary you're making. It was also quite interesting to note that an engineer has many different career paths available and that not all engineering jobs require extensive use of A Math 235. And for all you ChE s out there, only one copy of Perry's was found all summer.

It didn't take long to meet the two-hundred or so other supplementals working

(please turn to page 19)

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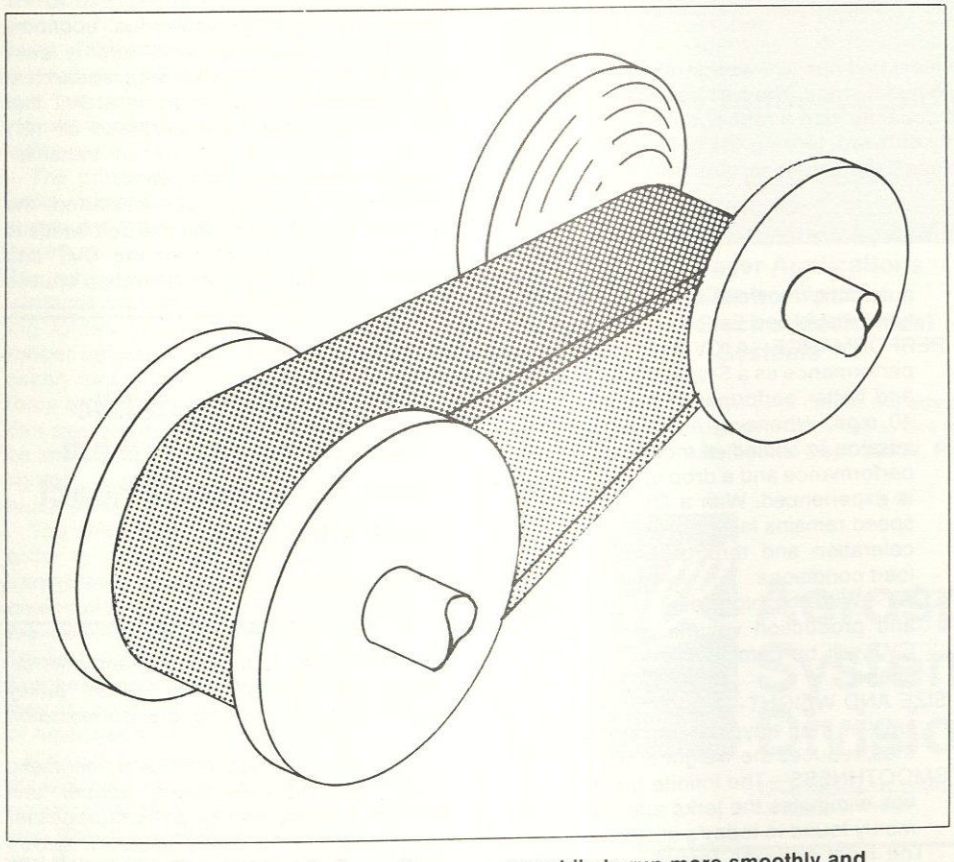
Shifting Gears



Continuously variable transmissions allow an automobile to run more smoothly and efficiently.

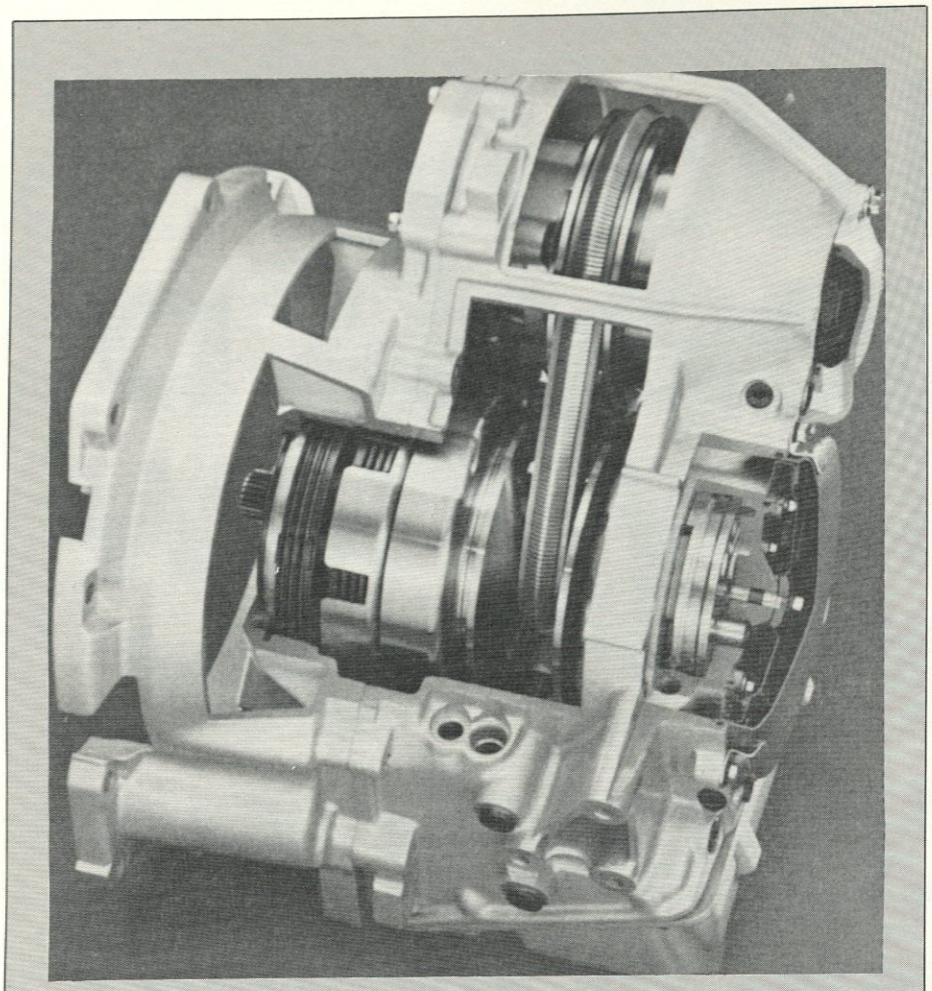
by William H. Sawicki

Automakers on every continent are on a continuous search for ways to increase automobile efficiency. Everything from plastic body panels and engines to turbo chargers and over drive transmissions has been tried. Many advances have been made, and the cars being built today are certainly more efficient than their predeces-

This contraption could . . . make conventional automatic and manual transmissions obsolete.

sors. However, a not-so-new device that is currently being (re) developed could rock the entire automobile industry. This contraption could significantly improve automotive performance as well as mileage, and at the same time, it could make the conventional automatic and manual transmissions obsolete.

This mechanism, commonly called a continuously variable transmission (CVT), was first introduced in 1958 as the Variomatic



Fiat's Uno-matic 70 utilizes a metal belt. The steel belt has 320 wedge-shaped blocks that are free to move along two flexible metal strips. The belt transmits force by compression and provides greater torque capacity than a rubber belt. As the pulleys vary, the steel blocks are wedged radially outward, tensing the belt. Blocks on the driving pulley are in compression and transmit the engine torque.

CVT for the DAF automobile. A similar version of the Variomatic is presently used in the Volvo 340 (not sold in America). At least four overseas automakers are developing (or have developed) a CVT, and Detroit is not far behind.

A CVT is a transmission that operates smoothly without gears and promises a boost of up to thirty percent in fuel economy over standard automatic transmissions. Controlling the ratio between the engine and the power train continuously rather than in steps, as with gear-type transmissions, lets the engine operate at its optimal fuel consumption level at all times.

Besides a boost in economy, there are several other aspects that make the CVT so economical and practical:

SIMPLICITY—The CVTs have a definite advantage when it comes to manufacturing and repair. Ford's experimental CVT, the CTX-811 (Continuously variable Transaxle), has about 35 percent fewer moving parts than the torque converter automatic transmission found in production Fiestas and Escorts.

PERFORMANCE—A CVT offers the same performance as a 5-speed at low speeds and better performance at speeds over 40 mph. Whenever a fixed-gear transmission is shifted, a momentary loss of performance and a drop in engine speed is experienced. With a CVT, the engine speed remains fairly constant during acceleration and through widely varying load conditions

COST—With the high level of competition and production volume, the price of a CVT will be comparable to that of a 5-speed.

SIZE AND WEIGHT—A CVT is significantly smaller than a typical transmission and thus, reduces the weight of the vehicle.

SMOOTHNESS—The infinite number of ratios eliminates the jerks and steps commonly found in today's automatics.

The most common format of a CVT utilizes pulleys and belts made of either rubber or steel. Traction devices and hydraulic systems are also being developed for CVT use.

Traction devices, in which the power is transmitted from one rolling element to another, have been around for fifty years but have made few advances into today's auto market. These transmissions suffer from complex mechanical problems (including low durability and limited power capabilities) that are difficult to correct. For general use vehicles, these drives are not very practical, and at the moment, automakers' interest in them is minimal.

The belt and pulley configuration is by far the most versatile and advantageous. Automatic shifting in this type of CVT is achieved with a belt moving over a pair of longitudinally-split, variable-diameter pulleys, each one with a fixed half and a moving half. When one of the split pulleys moves apart, allowing the belt to ride further down in the valley formed between the two halves, the other split pulley comes together, forcing the belt to ride higher in its groove. Effectively, the diameter of each pulley is constantly changing.

Conventional transmissions provide only a few discrete gear ratios between the normal low and high gears—three to four in an automatic and up to five on a manual. A CVT operates in a stepless fashion, varying between the fixed low and high ratios. The spread ratio of the new Fiat Uno-matic 70 CVT is 5.55:1 (meaning the highest gearing is 5.55 times the lowest). Today's automatic transmissions have ratio spreads of only 3:1 or 4:1. Increasing the CVT spread to 7:1 would yield a thirty percent fuel economy advantage. A Japanese automaker is looking to do even better by funding research at the University of Wisconsin on a CVT that can operate with a spread ratio of 10:1 (which is equivalent to a manual transmission with more than eight gears!).

Generally, when the car is started, the drive pulley around which the belt winds is at its smallest diameter so the CVT can operate on a low ratio. Acceleration causes the drive pulley to close, increasing its diameter. Concurrently, the driven pulley opens, gradually raising the transmission ratio.

The American public would finally have full-size cars with compact car efficiency.

The pulleys are operated by a pneumatic (Volvo) or hydraulic (Ford) control unit which is commanded by a microprocessor (as opposed to a bulky vacuum system utilized in the DAF). The Ford control system receives input from the ignition coil

(which monitors engine speed), an inductive sensor installed in the speedometer (which monitors car speed), and a potentiometer (which monitors throttle angle).

The control unit works continuously and spontaneously. At light throttling, the CVT converts to a high ratio to maintain optimal fuel economy, and a sudden change for maximum acceleration would switch the system to the lowest possible ratio.

Rubber or steel belts may be used. The principal of operation is the same with either type of belt, except the rubber belt works under tension and the steel belt is under compression. Durability is the main drawback of the rubber belts. The earliest of these belts rarely lasted more than ten-thousand miles. Automakers are requiring a minimum life of eighty-thousand miles. With the increased emphasis on CVTs, this goal should be reached.

In order to improve the belts, the wear from cyclical forces such as tension and bending must be reduced. The lowest possible tension gives the greatest response to changing loads; therefore, the belt must be tight enough only to prevent slippage. The DAF belts were installed too tightly, thus reducing the belt life dramatically.

Another indication of the new developments in belt design is the increased power capacity. The two belts operating in tandem in the DAF delivered only 26 hp, whereas the twin belts in the Volvo 345 deliver almost 75. The research has begun on a single belt that would effectively replace the double belts. The Gates Rubber Company is developing the Power-Trac belt which reportedly has twice the power of current CVT belts. This belt is constructed of molded, trapezoidal, rubber blocks fastened to a flat-belt tension member. Steel reinforcing members help to increase the transverse stiffness.

The power constraints make the rubber belts compatible mainly with small, commuter-type vehicles—a market that American automakers are not too fond of. The rubber belts, however, have many advantages over the steel ones: the axial loading forces in the CVT are lower with a rubber belt because the frictional force between rubber and steel is greater than the force between steel and steel; a rubber belt can operate dry, whereas a steel belt must be immersed in oil at all times; rubber is also lighter, potentially less expensive, and much easier and cheaper to replace.

The factors that must be overcome in order to perfect the continuously variable transmission are great. Compact cars with engine displacements of less than 1600 cc. are now benefitting the most from CVTs. These cars represent a large share of the European and Japanese car markets, but they account for a much smaller percentage of American sales.

If a CVT can be developed for larger cars, the U.S. may become the greatest market for automobiles featuring this not-so-new device. The automakers would then be happy, and the American public would finally have full-size cars with compact car efficiency. ✲

First Impressions —

by Keri Saelens

LOST

One freshman engineering student. Blonde hair, blue eyes, approximately 6 feet tall. Answers to the name Keri Saelens. Last seen wandering the halls of the engineering center. If found, please return to the Deans office.

ENTER

Wandering through a maze of institutional gray walls, hopelessly confused and disoriented, has convinced me that the most difficult part of earning an engineering degree at C.U. is getting to know your way around the engineering center. If you can master this you're half-way there.

The first step of the college's weeding out process is the encounter with a building designed to be both sinister and imposing. The stark outer walls of the center are relieved by occasional windows and double doors which seem to form toothless, grinning faces. And indeed, during the first week of classes they delight in gobbling up unsuspecting freshmen and spitting them out through the revolving doors in a condition bordering paranoia.

Finding a class is like searching for the fabled Fountain of Youth. Actually, by the time I found my aerospace lab, I could have benefitted immensely from those waters. In trying to find the lab, I discovered every obscure nook and cranny in the entire place. Reagan ought to consider basing the MX missiles in the engineering center!

I started in the classroom wing and attempted to combine their artistic talent with the workable approach that engineers use to create found remark designed to reassure the doubtful. What is it about spending money that fogs otherwise intelligent minds? Whoever was in charge of overseeing the plans of the engineering center must have been boggled by the grandeur of the project, because he or she forgot to pay attention to the little details. For instance, would it have been too much trouble to include some basic compass directions on the diagrams? Honestly—you just can't find good help these days.

Well, I forged off in the direction (I thought) of the aerospace wing. The first obstacle was a staircase which started inside the building and, after a series of twists, exited onto a courtyard instead of what I thought was going to be the bottom level of the same building. This level (zero) resem-

bles a high-tech maze, reminiscent of Rome with its columns and fountains. For a moment I wondered if, like Tron, I had been transported in time.

I headed for the first door in what I thought was a northerly direction and ended up in the chemical engineering wing. Walking past a group of what were obviously graduate students, I attempted to look nonchalant—as if I belonged.

Seeing a staircase going downward, I thought perhaps I had misinterpreted the diagram and that the zero level was down even further. I descended. Down, down into the dark bowels of the engineering center I went. To my dismay I was in the boiler room. I seriously considered remaining among the cobwebs and steam rather than embark back upon my perilous journey. However, reason prevailed in my numbed mind, and I realized that there was no other alternative than to back track past the same group of graduate students. This time I tried to achieve an attitude of preoccupation, but I caught some amused glances.

The quest went on—as door after door failed to reveal the aerospace wing, I kept expecting a voice to say, "Keri Saelens, Come on down! You're the next contestant on the Price Is Right!" Actually a little divine intervention about then would have been appreciated.

Finally I went through a set of double doors labeled ME which I had logically deduced to mean mechanical engineering; in desperation I was willing to try anything on the zero level. Of course that was the aerospace wing. You figure that one out. Next time I'll disregard logic and just go to the most illogical place imaginable. ✲

EXIT

ENGINEERING A DESIGN

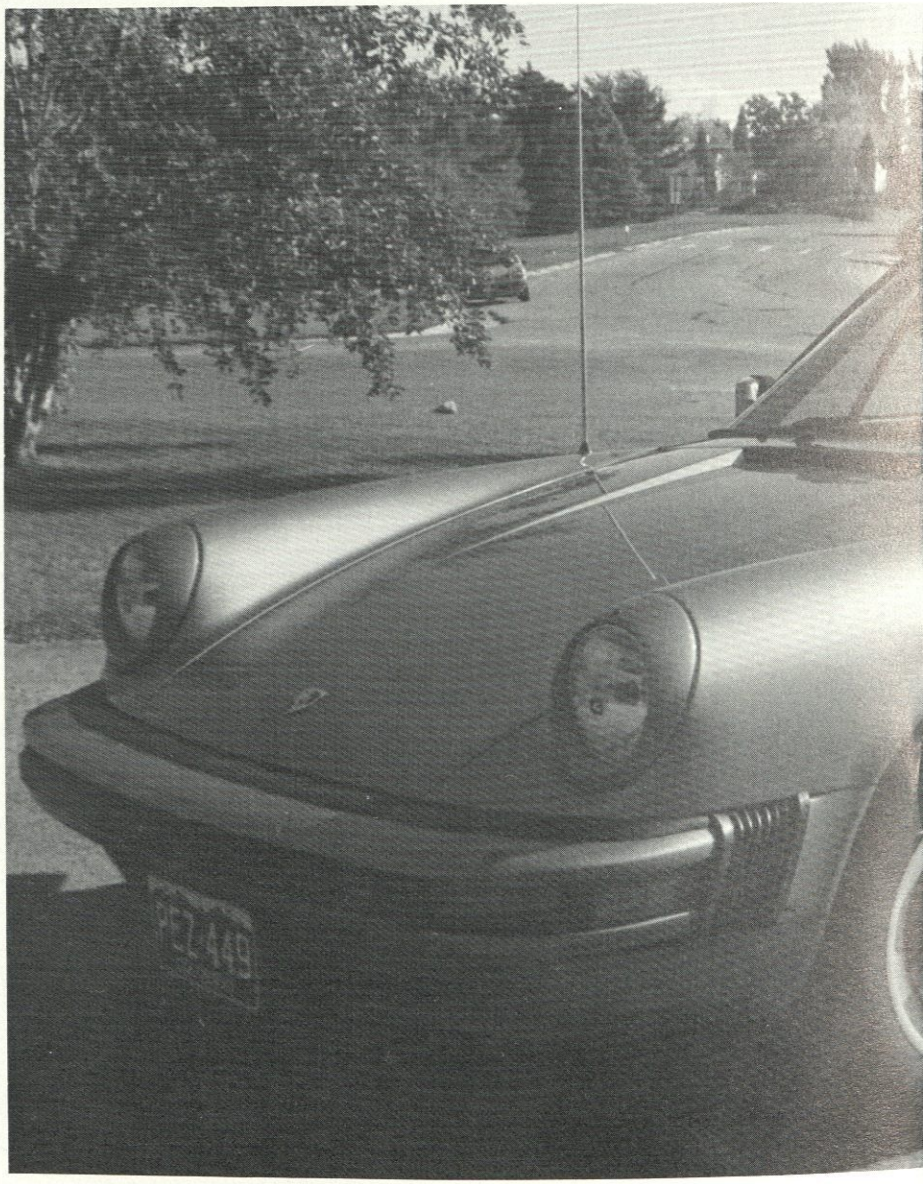
The Art of Science

by Jim Curlander

You're driving down the Boulder Turnpike in your Volkswagen Bug when suddenly, *whoosssh,* a flawless, sleek, low vehicle passes you at nearly twice your speed. "A maniac," you think, because he's going faster than you; you sure would like to have that car. As a matter of fact, you'd like to have any car like that. Or perhaps you're one of those people like this author, who would simply like to have **any** car. One way or another, you're bound to ask that immortal and perplexing question, "Where do automobiles come from?" No, the answer is not Detroit, or Japan, or Germany (depending on how much money you have). In many cases, the answer is Pasadena, California.

Located in the city famous for its annual flowery parade is a College of Design with one of the best reputations in the free world. The Art Center College of Design specializes in curriculums that are entirely oriented toward fine arts in combination with efficient attractive design. Unlike the University of Colorado, the Art Center offers more than just Environmental Design. In fact, no less than ten other majors stemming from six different departments are offered: Communications, Film, Fine Arts, Illustration, Industrial Design, and Photography.

Students at the Art Center are striving toward positions in the business world that combine their artistic talent with the workable approach that engineers use to create the final product. In short, the Art Center is turning out not simply design graduates, but



Head designers at Volvo, Porsche, Toyota, Mitsubishi, Nissan, and Honda are all Art Center products.

hybrid personnel that understand both the engineer's and the designer's point of view.

Because many industries—automotive in particular—employ both designers and engineers, the hybrid qualities of the Art Center graduate are most obvious in the Industrial Design department. Offered in this department are the majors of Environmental Design, Product Design, and Transportation Design.

Environmental Design is the study of space and structures, and their relation to the human form. A student pursuing this major at the Art Center can not expect to deal with any hypothetical problems. In fact, the program's concentration on budgetary, statistical, physical, and political realities uniquely prepares the graduates for a wide range of career opportunities.

The College claims that its graduates in Environmental Design can work for architectural or consulting firms designing interiors for efficient yet attractive use of space. Other possibilities for Environmental Designers include careers in transportation involving the design of interiors of railway and subway cars, airplanes, or perhaps even spacecraft. Still others may be involved with new frontiers of human society such as underwater habitats. Whatever the job, the need for a combination of design talents with engineering produces exciting new horizons to be overcome by the designers of the future.

Where do automobiles come from?

Product Designers must be more socially and economically in touch with general society. To develop the ability of determining the wants and needs of the public, Product Design must take part in advanced individual projects working directly with consumers, scientists, and marketing personnel.

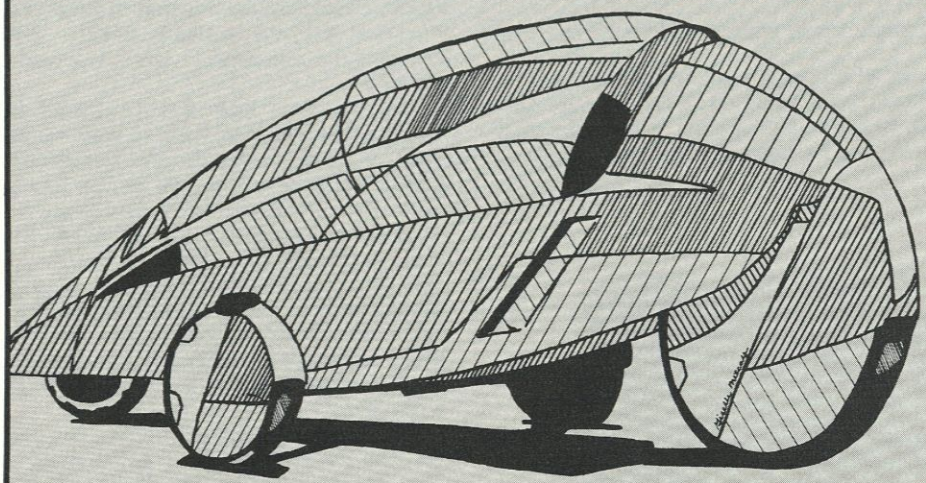
The graduates from the Art Center in Product Design are the people who will be creating the toys, industrial and recreational equipment, and appliances of the future. They must constantly have their finger on the pulse of the general public. These Product Designers can expect to have any number of career opportunities ranging from graphics to human factor engineering. Other options include joining a design staff with specialized responsibilities, or becoming freelance designers in business for themselves.

The final Industrial Design major, the one that has put the Art Center on the map, is Transportation Design. The Transportation Design major is actually a combination of both Environmental and Product Design plus a specialization in transportation. The Transportation major begins with a fundamental curriculum that includes drawing, layout, perspective, and communications. Later classes include three dimensional model construction, product design, and structural theory. Upper division requirements stress mostly advanced design courses and projects.

Transportation Design students emphasize conservation of materials and development of new resources. For this reason, they are seriously concerned with new energy sources and the relationship between the behavior patterns of the general society and new transportation ideas. A special feature of the Transportation Design department is its contact with the professional world. It is common for GM, Chrysler, Ford, Porsche, Saab, Toyota, and other Japanese and European automobile companies to send representatives to the Art Center to critique the students' new designs. The head of the Art Center's Trans-

"If I could fire all my designers and replace them with only Art Center graduates, I would."

Rolling Sculptures



This sleek vehicle may be a future product of General Motors. Designed by Rob McCann.

As any good engineer knows, aerodynamics is an important aspect of the efficiency of any earth-bound vehicle. This is why it is the number one influence in both design and engineering at the Art Center.

In city driving at low speeds, the shape of a car is of little consequence. However, at high speeds wind resistance can make an enormous difference in the efficiency of an automobile. In addition, sleek, low vehicles are generally more aesthetically appealing than ragged, boxy ones.

At fifty-five miles per hour, a conventional family car uses approximately sixty-five percent of its horsepower and sixty percent of its fuel just in overcoming air resistance. American car makers are only now beginning to realize this and are applying it to their new auto designs. In fact, General Motors is the only major American car maker that has installed a wind tunnel in order to aerodynamically test their newest models. On the other hand, Pininfarina SpA, a fifty year old European company, famous for its design work with Porsche, Ferrari, Mercedes-Benz, and Rolls Royce, has understood the necessity for wind tunnel testing for years.

As the head of the Transportation Design program asserts, good design requires good engineering, and good engineering requires adaquate use of high technology. In keeping with that philosophy, the Art Center requires transportation design students to make use of the wind tunnel made available by the California Institute of Technology. As a result, many of the students are on the frontiers of modern, no frills design tradition.

In the future, consumers should not expect to see new automobiles with fancy hood ornaments or eye catching, wind resistant fins. Tomorrow's cars will be nothing less than sculptures—rolling sculptures for the road.

portation Design program, Keith Teter, is a twelve year veteran of the Ford design staff that produced such classics as the Mustang, the Maverick, and the Mach I.

Upper division student projects generally include work for one of the major automobile makers. For this reason, Transportation Design graduates have a immense number of job opportunities. Students who earn a degree are few and hard to find. In most cases, they are hired by the big automobile companies right out of school. To quote some statistics, "At least half of America's thousand or so car designers are graduates of the Art Center. The design departments of the major Japanese car companies are controlled by Art Center graduates, and they are prominent in Europe as well."

The reason for such prominence is obvious. The average Art Center graduate must be a cut above other graduates of the same major elsewhere. It is the combination of their artistic and engineering ability that makes the difference. To become an Art Center graduate is extremely difficult. In fact, the entrance requirements alone pose quite a barrier to all but the most dedicated students.

Twenty-five percent of Art Center entrants already have a bachelors degree in another field, while more than half have at least two years of college behind them. Every entering freshman must submit a complete personal profile as well as a portfolio containing at least twelve original works pertaining to his or her intended major. Beyond that, an annual tuition in excess of $6000 with supply costs that can exceed $1000 keep the less serious away. Finally, the College has no dormitiories, so students must seek accommodations locally and can expect to pay two to three hundred dollars per month for a small apartment. However, all the expense and hard work is worth it when one considers the achievements of the "average" graduate.

At least half of America's thousand or so car designers are graduates of the Art Center.

In addition to its impeccable reputation, the Art Center boasts an Executive and Advisory board made up of some of the most famous and powerful people in the United States. Such members include: Ray Bradbury, author; William Clay Ford, Chairman of the Executive Committee, Ford Motor Company; Lee A. Iacocca, Chairmen of the Board, Chrysler Corporation; Irvin W. Rybicki, Vice President, General Motors Corporation; Richard A. Teague, Vice President, American Motors Corporation; and

Keith Teter , Chairman
Industrial design department
Art Center College of Design

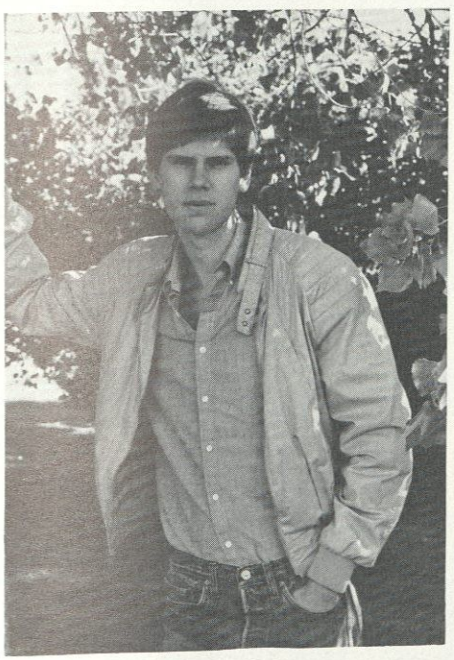
many other prominent names in the fields of film, photography, and artistic design.

The Art Center College of Design maintains a unique and wholly essential part in the future of design. As consumers, we can expect to see great leaps in efficiency and utility in nearly all aspects of our daily lives. Next time one of those sleek, low vehicles passes you on the turnpike, just remember what had to happen before that "maniac" got behind the wheel. ✲

SOURCES:
1. **Smithsonian Magazine**, February 1984.
2. **The Economist Magazine**, April 9, 1983.
3. The Art Center College of Design catalog, 1983-84 edition.

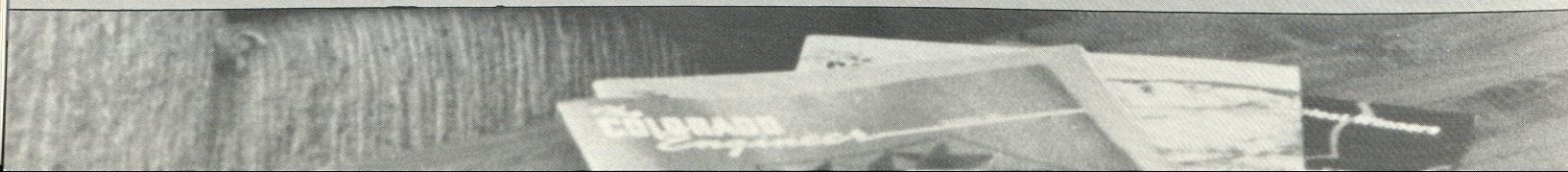
The Colorado Engineer would like to thank Kathleen Cahill for the use of her 1982 Porsche 911, which appears on the cover. Cover and related photography by Jim Curlander.

The automobiles pictured with this article were not necessarily designed by students or graduates of the Art Center. Rather, they represent the automakers that employ Art Center graduates.



Jim Curlander claims to be a sophomore in electrical engineering, but his real interests lie in photography, skiing, guitar, and partying.

I settle for nothing but the best. The best food, the best wine, the best cars. So when I chose my magazine, it had to be the **Colorado Engineer,** because I'm worth it.



(continued from page 7)

for IBM in San Jose. They came from various universities in Washington, Michigan, Maryland, South Dakota, New Jersey, etc. Most were either engineering or computer science majors and all upheld the image of working and playing hard. Many weekends were spent on excursions to San Francisco, Monterey, Lake Tahoe, Yosemite, Santa Cruz, or just relaxing with a sailboard at a local lake.

Needless to say, we did not have much to show monetarily for our three-month "vacation," as our managers would sometimes kid. Flipping through my many photographs always gives me a smile while reminiscing about friendships made and the crazy things we did. It was especially fun to work all summer with such an amusing (and opinionated) office-mate, Vicky, who also is looking forward to graduation from CU this spring. All of us are hoping to have a reunion at some snow-covered resort this Christmas.

Being an IBM supplemental was indeed worthwhile. The job experience and "fun in the sun" was more than one could ever ask for. Even more important was the knowledge gained in determining some previously uncertain professional goals. Engineers these days have a great many options available after completing the BS. It really helps to get a little taste of the "real job" world, in whatever way you can, to see what kind of niche is right for you.

Reality — Here I Come

by William Patterson

"Get a haircut, and get a job." How true these words ring. Last semester I thought to myself, "What have I got to lose by trying something different this summer?" I'll redirect my job search toward "gainful" employment. Maybe this would give me a good chance to apply all the theoretical knowledge, which I have supposedly accumulated, toward the real world. Isn't this the main reason for me being in school?

So I decided to put together one of those things—I think they call it a resume—that is ninety percent fantasy and exaggeration and went from company to company selling myself. I told them I was cheap and easy. All the hounding paid off, as I got a job with Honeywell, the company that makes thermostats, in their Research and Development office in Minneapolis.

"Get a haircut, and get a job." How true these words ring.

At first, I imagined myself as the little assistant boy on the projects, cleaning up the laboratory at the end of each day and fetching pencils and paper upon request. Nothing could have been further from the truth. During the summer, I did a great deal of research and analysis on two projects.

When Honeywell, or any other company, bids for a government project, they must bid low in order to get the contract. This puts a considerable restraint on the project's budget. Since most of Honeywell's top engineers would cost too much to be used full-time on a single project, a large portion of the research and analysis is allocated to the interns.

One of our projects was called Dynamic Retraining. The project's goal was to develop a real time program that would dynamically update voice recognition templates. The user would record a set of templates, and as his voice changed due to stress and strain, the program would determine which template was going bad and swap it with a better one.

The application of the project was geared toward pilots. Dynamic Retraining would free the pilots from several of their hand controls, using the voice controls instead.

The program wrapped up with over fifty subroutines, and in one way or another, four people were involved with the code. The summary for Dynamic Retraining was finished and submitted the day I was to return to picturesque Colorado. It was exciting to have the project finished. It gave me a feeling of accomplishment, expecially since I had worked on the project the entire summer, including weekends and plenty of overtime.

I told them I was cheap and easy.

The other project I worked on was called Personal Protection Project, or P3 for short. The objective of this project was to test several helmet shields to determine which shield would protect the eyes against a laser attack and still give the user good visability.

I had to write several subroutines on a Honeywell level 600 (similar to the infamous VAX) and run the subjects through the experiments. This taught me a lot about running and executing an experiment. The results obtained from the experiments were more often than not contrary to what we were expecting.

My greatest learning experience of the summer, however, was interacting with other people on a group project. In order for a project to run smoothly and yield decent results, the individuals of the group must have complete communication and strong interaction. I am now more excited then ever to graduate and forge out into the working world to make my dent.

Lab-Teching In Boulder

by Gwen Horn

"How I spent my summer vacation"—(Somehow I thought I'd seen the last of this title after leaving 9th grade English). I spent my summer working for the Department of Commerce as an employee of the National Bureau of Standards (NBS) in a Chemical Engineering lab here in Boulder. You may be wondering what a Chemical Engineering lab has to do with the Department of Commerce. Research is done at NBS to provide industry with basic data for use in application to large scale processes, and to develop standard procedures for taking such data.

Getting this summer job was not done through the typical route of sending out resume after resume and interviewing

through Cooperative Education. Instead, I interviewed last December for a part time job after hearing about it when a professor announced the job in class. Getting the position at NBS last semester, I worked about ten hours a week.

When the opportunity for a summer job with NBS arose, I decided that summer in Boulder on my own would be fun. Besides, I really enjoyed the job. The projects that I worked on in the lab dealt specifically with separation techniques for liquid mixtures and gas mixtures.

I worked with an apparatus that is designed to measure rates of gas separations. It consists of a cell containing an immobilized liquid membrane, which is a type of porous support (e.g. filter paper) impregnated with a liquid, and a flow system which provides for analysis of various gas mixtures.

The main purpose of the experiments performed was to analyze a given gas mixture in terms of the diffusion of the various gases across the membrane. For example, "Does one gas travel across the membrane much more rapidly than the others present?" If so, the membrane system being analyzed may be useful in separating out this gas in industrial applications.

The first part of my summer was spent modifying a data acquisition program for the gas phase apparatus and conducting a literature search to collect data for a gas mixture that would be run later in the summer. I also spent some time helping to make the gas separation apparatus leakproof, which meant getting inside of the apparatus with a couple of wrenches and a leak detector.

For the majority of the summer, I ran experiments and analyzed data. I also carried out a couple of short-term projects. I wrote a computer program that actually required the use of my new knowledge (gained last semester) in Thermodynamics (Imagine! No wonder it still doesn't work). I also worked on the reconfiguration of one of the lab instruments for a new application.

I learned many things this summer, one being self-motivation. At the beginning of the summer, I had trouble taking initiative when something needed to be done, always wanting someone to tell me exactly what to do. As the summer progressed, I got better at doing things on my own, and that's one of the most important things I learned.

. . . which meant getting inside of the apparatus with a couple of wrenches . . .

My job and the area of Chemical Engineering that I worked in was very interesting and challenging. When the results of an experiment weren't as expected, it was fun to sit down and try to figure out what could have caused the discrepancy. I discovered that working in a research type of environment is enjoyable, and this has helped me to decide what aspect of Chemical Engineering I want to pursue.

All in all, this summer in Boulder was a pleasant experience. There was plenty of time for playing racquetball and Trivial Pursuit, eating Steve's Ice Cream, and just enjoying the relative quiet of Boulder without 22,000 students. I learned a great deal about gas properties and liquid membranes, the working environment in general, and a whole lot about plumbing!

As the summer progressed, I got better at doing things on my own.

A Summer SEED

by Monna Wang

"I was a seed for the summer." Sounds almost as outrageous as "The Attack of the Killer Tomatoes." Actually, I was no ordinary garden-variety seed. Seed, or more correctly, S.E.E.D., stands for Student Education and Employment Development, a summer job program geared specifically toward engineering and computer science majors at Hewlett Packard. Hence, the unfortunate title SEED was affectionately bestowed upon all the students who were selected into the program.

You can imagine the hazards which come with being called a SEED. Related terminologies such as WEEDs and SPROUTs immediately came to mind. One of the standing jokes among the managers was, "This summer will distinguish the weeds from the sprouts." Of course we all worked feverishly hard so as not to have the unfortunate fate of being labeled a WEED, thus terminating our existence at HP forever. At any rate, the whole intent of the SEED program is to nurture us lowly SEEDs so that, hopefully, we may sprout one day and come back to work as grown, productive HP-ites.

"This summer will distinguish the weeds from the sprouts."

Even before the campus interview, I was impressed with the casual and open atmosphere which HP seems to present. At least that is what their campus recruiting pamphlet said. I wasn't disappointed, but don't let the casualness fool you. I found the expectations which HP has for its employees to be quite high. The key ideas are self-motivation and personal initiative. Your boss is there for guidance and to act as a reference and consultant. It is up to you to utilize the various resources available, and in addition to ingenuity and initiative, to get things done. I found the people in HP to be my best source of reference. I was impressed with the highly technical, competent, and motivated individuals with whom I had a chance to work and/or talk.

The same pamphlet also claimed that HP strongly believes in continued-learning and advancement. Well, I sure verified that claim in a hurry. I arrived for my first day of work, ready to get some real "hands-on" experience, and was promptly informed that I was enrolled in a HP-IB (interface bus) course down in Englewood for four days. So the next day I was back home attending classes again. I also went to several seminars and a class on team work training during the summer. I never thought that I would enjoy going to classes so much, especially when someone was paying me to go.

I worked in the HP Loveland Instrument Division. There were about 24 SEEDs working in the Loveland facility this summer. They came from all over the country, including two from Europe. One nice thing about being selected into an organized program

like this was the list of group activities which HP sponsors. Not only did we have a project or two to work on during the summer, but we were also strongly encouraged by the management to attend seminars, brown-bag talks, group luncheons, breakfasts with department heads, socials, cook-outs, and organized tours of various HP facilities throughout Colorado.

My assignment consisted of creating and developing an automatic and semi-manual performance verification, operation verification, and calibration software package for the HP3478A multimeter using the HP85B as the controller. If all this sounds like nonsense to you, well, don't worry about it. This is only an attempt to try to impress people with what I did this summer. I was given a typed memo describing my project along with project justifications, objectives, and requirements. To say the least, I was quite overwhelmed and also was beginning to get a little worried.

Helping to clarify my job assignment was a tour of HP Fort Collins Division. There the practicality of remote instrument control and programming, via the bus and through a controller (not unlike what I was doing),

another invaluable experience . . . the skill of working with people effectively

was really impressed upon me. We visited a basement facility which was referred to as "the dungeon," a testing site for unsuspecting computer prototypes. The computers were placed in various chambers to undergo severe electrical, magnetic, pressure, endurance, and noise tests. Under the harsh and intense testing environment and procedure, this sort of instrument control and programming becomes very essential and practical. The testing procedures are now more consistent and much easier, thus obliterating the sterotype image of a 3-headed and 6-armed operator.

Toward the middle of the summer, I also had the chance to call up several technicians. I explained to them what I was doing and what my goals were and asked for their inputs on the features they would like or not like to see in the new software package. This was good, "real-world" exposure for me. The technicians provided many practical measurement-process-related insights which I tried to incorporate into the program.

As if the benefits from working on a "real" project and encountering and solving "real" problems weren't enough, we were also besieged with gifts—everything from HP (yuppy) shoe laces to of course, HP calculators.

Besides accomplishing the project itself, another invaluable experience I obtained this summer was the less tangible but often essential interpersonal skills. The skill of working with people effectively, or even talking with people—trying to make your point as clear and precise as possible without wasting either your time or their time. I also tried to talk to as many managers and engineers from other departments as possible. Their experience and suggestions on career options will benefit me tremendously.

As the semester is settling in, along with endless homework, tests, and quizzes, I look back to this summer's work experience and can honestly refer to it as "the good times." For me, there is definitely something to look forward to after graduation. But, first thing's first. Now, about that assembly program . . .

What is Co-op?

A logical way to get a preprofessional summer internship is to go through the Cooperative (Co-op) Education Program. The purpose of Co-op is to help full-time undergraduate and graduate students gain work experience related to their academic majors prior to graduation. Sophomores and juniors are especially encouraged to apply, as they can participate in more than one co-op assignment.

Co-op assignments are available in a variety of schedules: full time during the summer, part time (10-20 hours per week) during the semester, and full time during the semester. An advantage of the summer and the part time assignments is that they do not interrupt the student's coursework. As a result, these are the two most popular schedules. Last year, 182 (62%) of the students involved with the Co-op program held summer assignments, 91 (30%) worked part time during the semester, while only 23 (8%) took a semester off to work full time.

There are numerous opportunities for placement both locally and nationally. Among the companies seeking technical majors are Dow Chemical, Monsanto, the Federal Highway Administration, the EPA, Rockwell, NASA, IBM, and the National Oceanic and Atmospheric Administration.

The Co-op Program is a division of the Career Services office, located on the ground floor of Willard Hall. Orientation meetings are held every Monday and Tuesday from noon to 1:30. Students are

Judith Moore, Engineering Co-op Counselor

assessed a twenty dollar processing fee for each academic year they are registered with Co-op. It is recommended that the summer job search be initiated early in the school year to increase one's chances for employment. For more information call 492-7353.

Co-oping Toward the Future

by Manuel Arellano

A primary object of your education as an engineering student involves learning to use tools. Books and professors are both tools used to gain a further understanding of a subject. In addition, lab work exposes you to various measurement tools common to your major. One of the most useful and often overlooked tools for supplementing your coursework is not a book, an instructor, or a lab instrument, but a program, the Cooperative Education Program.

If you look at your education as training

for a career, then no training program can be complete without serving an internship working in your chosen field. The sole purpose of the Co-op office is to help you find such an internship. For this reason, the Co-op program is one of the most powerful tools for helping you prepare for a career.

However, career experience is only one of many useful benefits to be received from co-oping. Two other important benefits are the relevance co-oping brought to my coursework, and the money I earned by working. At different times in my undergraduate career, all three of these benefits have motivated me to co-op.

In October, 1981 I was one month into my fifth semester of studying Electrical Engineering (EE) at Lehigh University in Bethlehem, Pennsylvania. Along with fifty percent of the other EE juniors I was failing the required course in Electronics. More important, for the first time as an engineering student, I began to seriously doubt my career choice. A large part of my indecision was due to my ignorance of careers available in EE. I did not know what an EE did for a living. My only knowledge of the field came through my coursework. However, as the coursework became more theoretical, my interest in EE began to drop—dramatically.

The Assistant Dean of Students suggested that I apply for a co-op. She pointed out that experience in the field of EE was necessary before I could make a career decision. I agreed completely. I knew it was important for me to see that there were careers in EE that were less theoretical than my coursework, while at the same time justifying the coursework as relevant.

I did not know what an EE did for a living.

Through the Co-op office at Lehigh, I received an offer for a fulltime internship with IBM in Burlington, Vermont. This internship lasted from January to August, 1982. By working at IBM, I learned that there were careers in EE that appealed to me. Also, I learned how useful a theoretical background is for solving common engineering problems.

After working for IBM, I transferred to the University of Colorado. I registered with the Co-op office when I arrived. My second semester here, I received an offer from the National Oceanic and Atmospheric Administration (NOAA) in Boulder to co-op fulltime the next semester. My initial reaction was to reject their offer because I wanted to graduate as soon as possible. However, I reconsidered because I felt I needed to both improve my lab skills and earn money for school. By working in their Instrument Development Lab, I gained proficiency in the assembly and testing of electronic circuitry. I enjoyed the work so much that I will be seeking a similar position in industry when I graduate. Also, I used the money I earned to pay for tuition and books the following semester.

The benefits I have received from my co-ops are numerous: experience in my field which helped me focus my career goals, money to apply towards school costs, and an understanding of the value of theoretical coursework for solving "real world" engineering problems. I encourage everyone to take advantage of this most powerful of tools, the Co-operative Education Program.

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TO STUDENTS, FACULTY and STAFF

FROM THE COLORADO ENGINEER

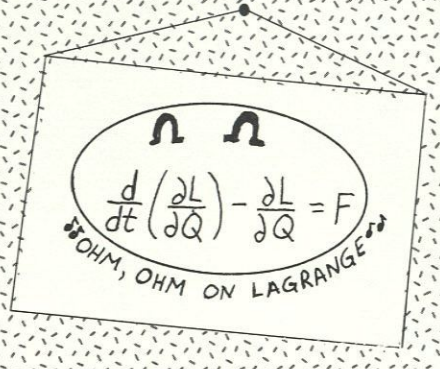
SUBJECT etc. (a new department in the Colorado Engineer)

DATE October 29, 1984

UNIVERSITY OF COLORADO

Interdepartmental Memorandum

The etc. page is a new department in the Colorado Engineer open to input from **YOU!** Contribute **your** original poems, jokes, drawings, limericks, cartoons, doodles, funny experiences, etc. for publication. Ideas can be dropped off at the Colorado Engineer mailbox in the Dean's office or at ST2-2.



THE ELECTRICAL ENGINEER'S LAMENT
(sung to the tune of "Onward, Christian Soldiers")

Onward EE soldiers, marching as to class
in the face of FACs, tempted by the frats.
Solving complex circuits, all sources unknown.
Though I set the lab up right:
"My God! The fuse is blown!"

Dragging HP 16-Cs the double Es march on
Arriving at the terminal to find the system down.
In the face of five exams, they find their HP gone.
Trudging through the micro-slop
to get those op-codes down.

Why are we in double E? Women are more fun.
Our social lives are limited to group studying 'til one.
Physics lab is such a drag; timing metal balls.
Soon I will be put away
in four soft padded walls.

Masochistic double E: it's my call in life.
My big reward comes later on . . .
a Ferrari and a wife!

Robert Lorentzen
Mike Voss

$\lim_{GPA \to 0}$ ENGINEERING = BUSINESS

$\lim_{GPA \to 0}$ BUSINESS = ARTS AND SCIENCES

$\lim_{GPA \to 0}$ ARTS AND SCIENCES = MARGARITAVILLE

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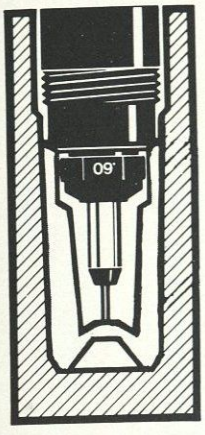

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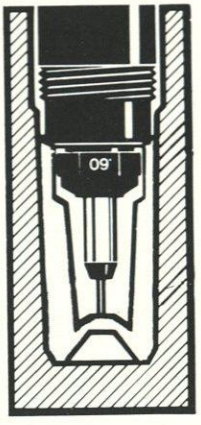

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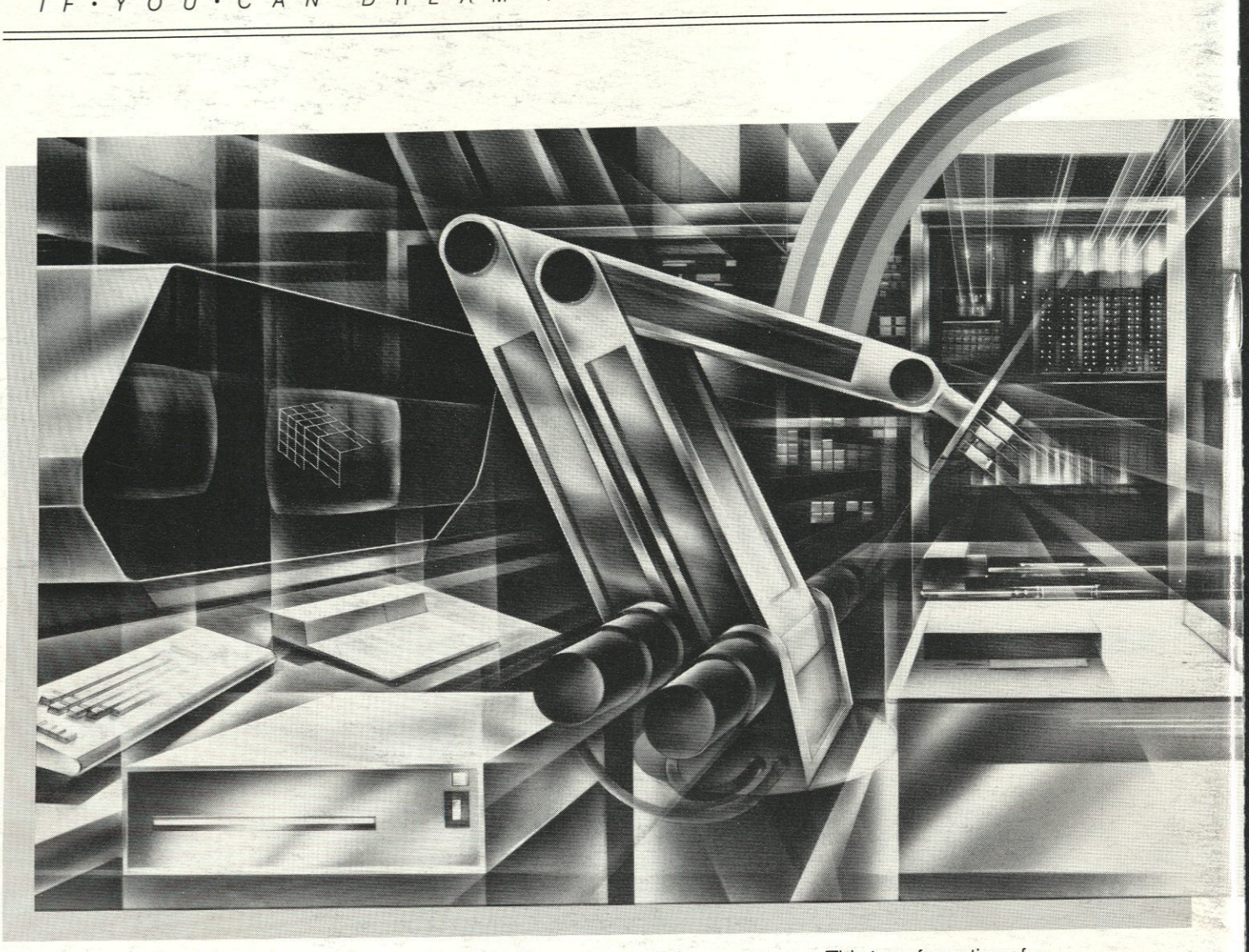

Convert the production line into a frontier of creativity.

The cast-iron technology of the factory will soon be silicon technology.

Chips and computers transfer design information directly to the factory floor. Other chips make possible flexible robotics, programmable controllers for machine tools, automated test systems and digital inspection cameras. Local area networks tie together all these systems.

These are revolutionary changes that can result in better-made products, manufactured of new materials at lower cost.

GE is deeply involved in bringing manufacturing into the silicon age. In one plant, electronics and computer systems enable us to reduce production time of a locomotive's diesel engine frame from 16 days to 16 hours. At our dishwasher production plant, a master computer monitors a distributed system of programmable controls, robots, automated conveyors, assembly equipment and quality control stations.

We're working on robots that can see, assembly systems that hear, and machinery that can adapt to changes and perhaps even repair itself.

This transformation of manufacturing from the past to the future creates a need for new kinds of engineers to design and operate factories of the silicon age. They have to be as familiar with the realities of the assembly line as with the protocols of software communications.

They will synchronize dozens of real-time systems whose slightest move affects the performance of every other system. The frontiers of manufacturing technology have been thrust outward. Old ideas have been questioned, new ones probed. Some ideas are now on production lines. Others are still flickers of light in an imagination.

All offer opportunities for you to seek, to grow, and to accomplish.

If you can dream it, you can do it.