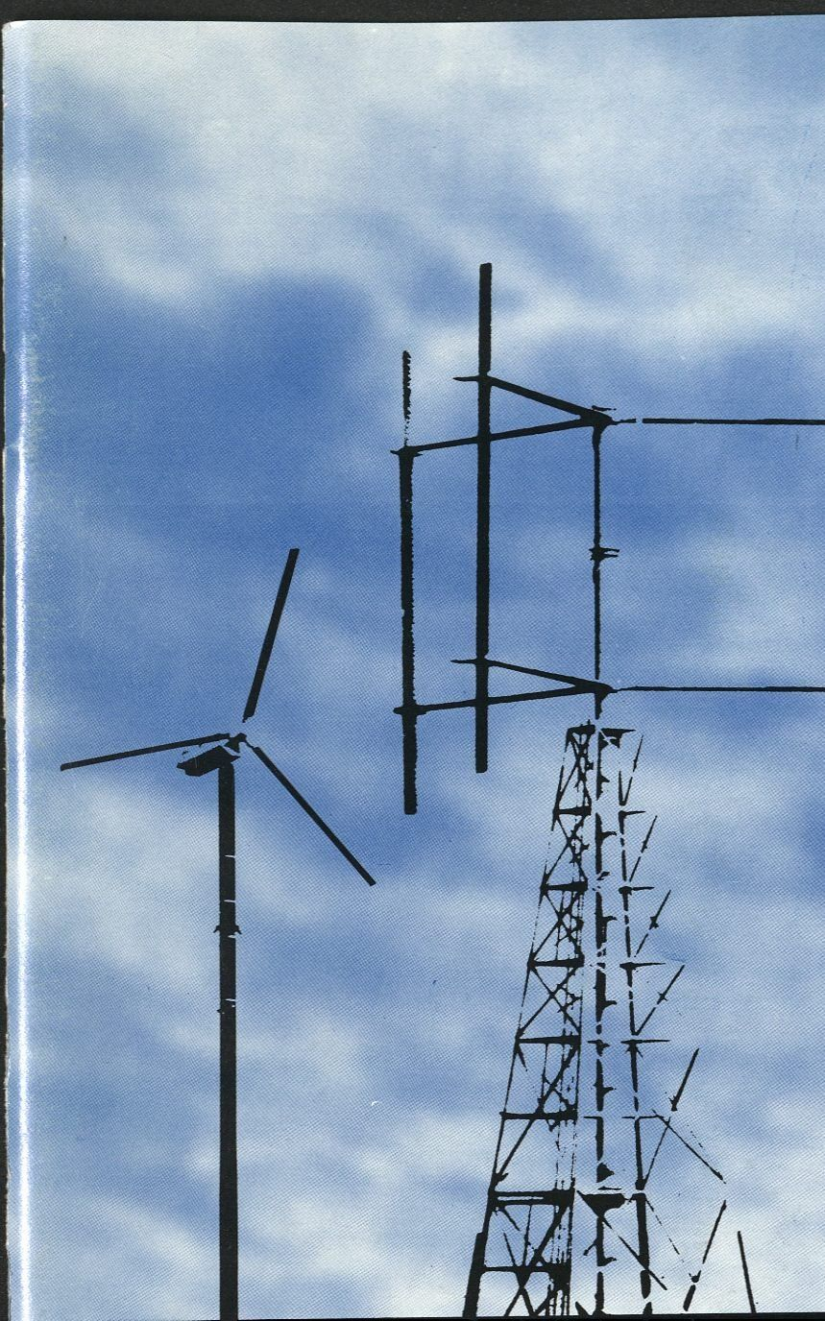

The COLORADO Engineer

FALL 1980

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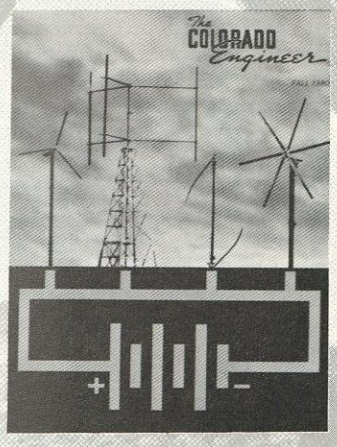
DEPARTMENTS



COVER

This month's cover, featuring windmills at the DOE wind energy project at Rocky Flats, illustrates graphically the idea that wind generators could provide continuous energy with the help of storage devices. For more details, see this month's article on "Watt's Up in Wind Energy." Cover design by Dave Kehmeier.

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The Editor's Outlook

The Trouble with Calculators

The sliderule has become a conversation piece more than the sure mark of an engineer and the "pocket" calculator reigns as master in grinding out the numerical answer. Getting that answer seems to be a lot easier with a calculator but that little electronic marvel brings along a few problems into the engineering students life.

A few fans of the "slip-stick" still claim it is better because it needs no batteries, and never dies during the middle of your final exam. But in an exam you can sit close to a wall outlet, and plug in your charger. So what if you find yourself stuck in the middle of the desert, and your batteries give out? But just what would you be doing in the middle of the desert with your pocket calculator. No, battery failure is not the big problem.

A more serious charge is that students who don't understand the simple and elegant principle of the slide rule are missing out on an important concept. This may be true. One professor claims that several students complained bitterly about an unfair exam question which required them to find the antilog of 100. None of their calculators would perform this operation it seems.

There is another problem with calculators in the classroom however. No longer is it necessary to resort to primitive methods such as scribbling your crib sheet on the back of your little machine. With a good calculator of the programmable sort you can put your notes right into the memory. A programmable calculator can hold formulas, constants, equations, and even lengthy definitions. This idea has certainly not been lost on many of the people who have such a calculator. One might argue that a student who takes the time to enter all this stuff must be learning it in the process, but it is not a very good argument. It is really not much harder to enter information in to memory than it is to write it inconspicuously on the back of the box.

So here is the question: is programming your calculator to help solve a potential test problem cheating or not? With the great drop in price for one of the little marvels in the past few years, it is reasonable for a professor to expect everyone in the class to have a scientific calculator. It is not reasonable to expect everyone to have a powerful programmable one however, since these are still relatively expensive and will probably go up, not down, in price in the future. The student with a more powerful machine could have a definite advantage at test time.

What's a professor to do? He could just hope that not much cheating goes on this way, but as the memory capacity of calculators keeps increasing, so does the potential to use them as a "cheat-sheet." Perhaps there could be a calculator expert stationed at each entrance to the exam room who would completely clear the memory of every calculator carried in. Then they could listen very closely for the sound of those little magnetic cards being read. A pretty silly idea, I'm afraid. Maybe there could be a list of calculators forbidden for use on exams. Then everyone with one of the black-list models would have to get a simpler one as well.

I have never liked exams which require rote memorization anyway, and here is one more reason to stop giving them. If a professor is going to allow the use of calculators, he may as well let everyone have a sheet of notes or make the exam open book. That sort of exam is a better test of ones ability to solve engineering problems, instead of to memorize the formulas.

It is also up to the professor to make his exam questions so that having a programmable calculator is no great advantage anyway. A program which does numerical integration for instance, should not be useful on a test. Questions which need complicated numerical work are best left for homework. Many professors do this already of course.

A professor can still forbid calculators, notes books and all, and ask how well you have stored information in your own memory banks, leaving the cleverly dishonest to use more traditional methods, like writing on a thumbnail. Or how about under that little cardboard sleeve on certain kinds of erasers? Believing that little machine like gospel may cause the downfall of a few who might be tempted to use it dishonestly. The amount of cribbing which one may get away with is still potentially great.

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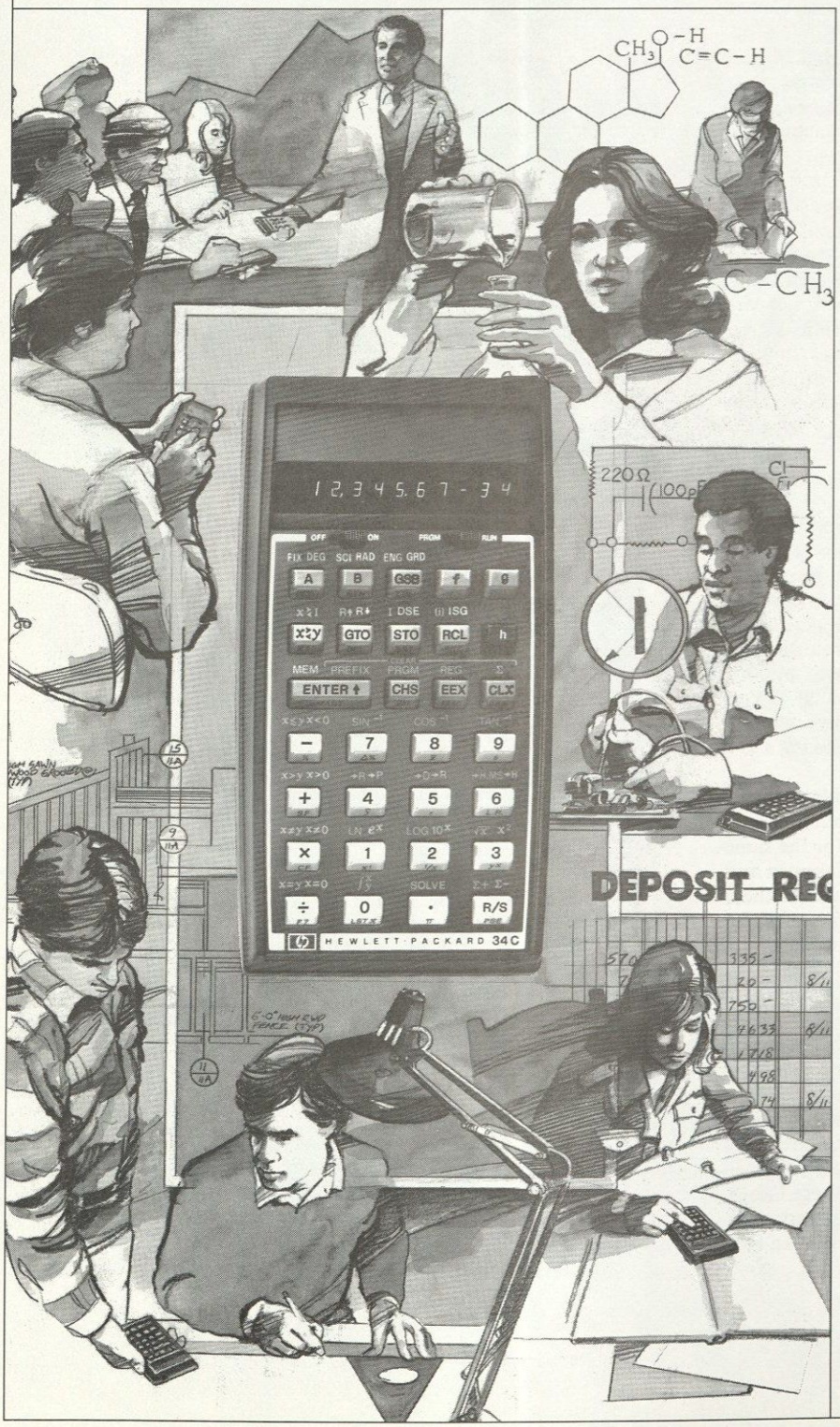

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HEWLETT PACKARD

Associate Editor's Column

Did you see a professor go by?

Have you ever had the experience of an upperclassman recommending a professor for a certain class and not only is he not teaching the class anymore, he is not even on the staff? Well this seems to be the going trend in CU's College of Engineering.

I am sure that everyone who was here at the time remembers the moment when CU's budget came before the Colorado Joint Budget Committee in the fall of 1979. Aside from our athletic department being in the hole and the threats that our Norlin Library will not pass the National Accreditation, we now seem to be losing some of our higher caliber professors for reasons beyond our (ahem!) comprehension.

Put your imagination into gear for a few minutes and go back to the year of 1966 with me. This is the moment you have been waiting for, the opening of the newest addition to this campus, the Engineering Center. At that point in time, the College of Engineering had the approximate enrollment of 1600 students. To help instruct these eager students were 120 faculty members (professors, etc.). The student-faculty ratio was a little better than 13 to one. This is not to say that all the classes were this small. This is the type of ratio (sometimes even a little lower) that is necessary for an engineer to acquire the help needed in order to graduate in the expected four years.

Now snap out of that dream and face reality. With no thanks to our beloved State Legislature, the need for faculty members is escalating every semester. At the present, we have at least 2200 enrolled engineering students and only around 96 faculty members. The student-faculty ratio is now up to 23 to one. Of course, I have yet to take a class that has less than 30 students, so this is a little difficult to comprehend. In 14 years, the enrollment has increased by 38% while the number of faculty members has decreased by 20%. You may ask, "what is happening to the high caliber teaching in Engineering?" Better yet, why are our high caliber professors leaving CU's College of Engineering?

Over the past two years I have experienced the problem of this deficit of professors. I have been closed out of a class that had only one section available and over 100 students registered for the same class. I have recommended some professors to lower classmen and have been told that they no longer teach at CU. Because of these incidents, I have taken the initiative to answer some of these questions.

When I had heard that one of the first EE professors I had for an introductory class had left the university that next year I was upset. I finally found out that he was offered a higher salary and better working facilities at another university out of state. This is reason number one that so many of our good professors decide to leave us.

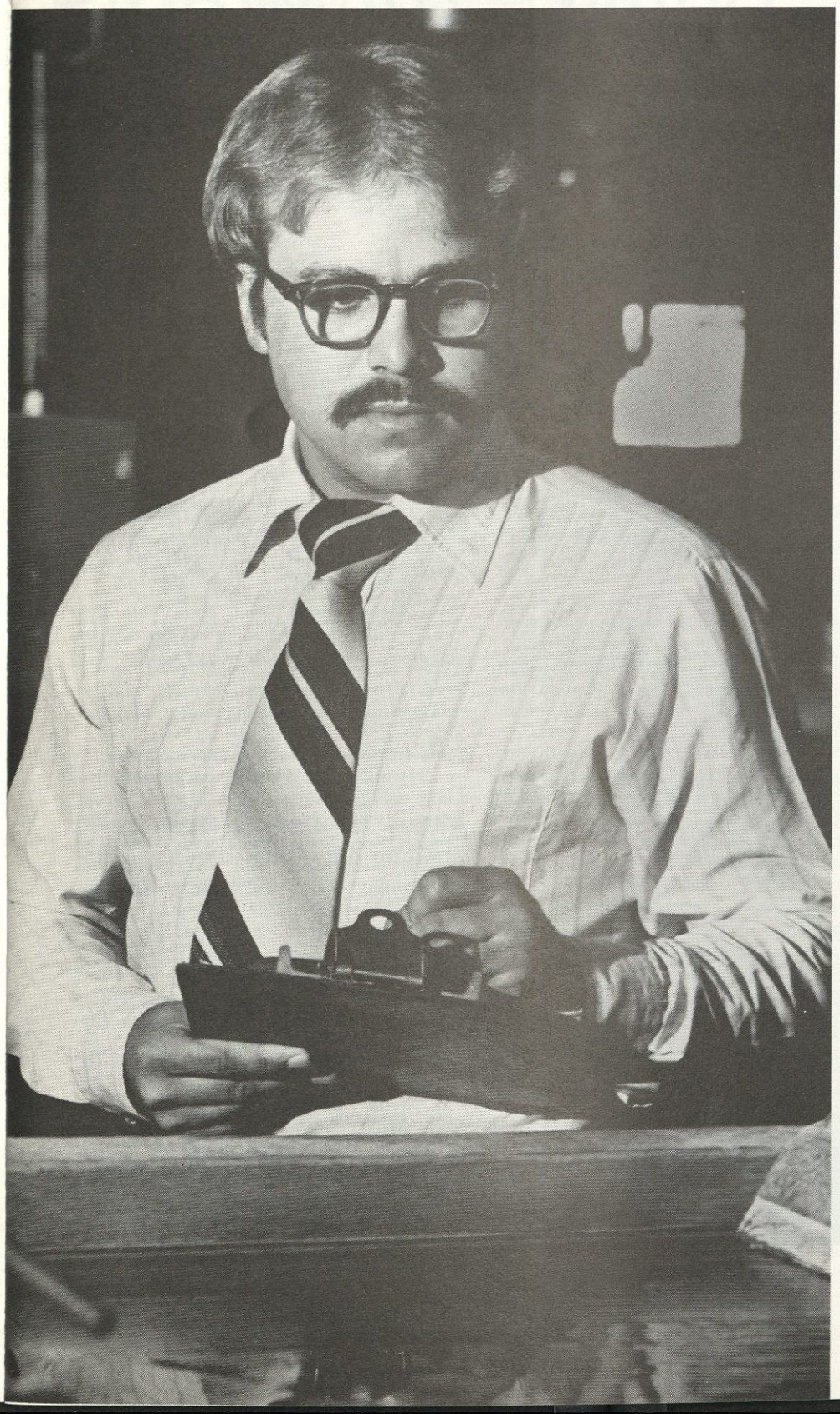
There is yet another excellent professor who has left us because he has started his own "hassle-free" business. It is apparently less of a hassle than the one here at the university. Finally there are more professors and even our Dean of Engineering that have resigned their positions because of the uncooperative Colorado Legislature.

If something is not done, either through the Engineering administration or the Colorado Legislature we will be left with the bare minimum of instruction at CU.

Nichol Poliac

"Can a new plastic be produced efficiently? It's up to me to decide."

Mark Carlson BS, Chemical Engineering



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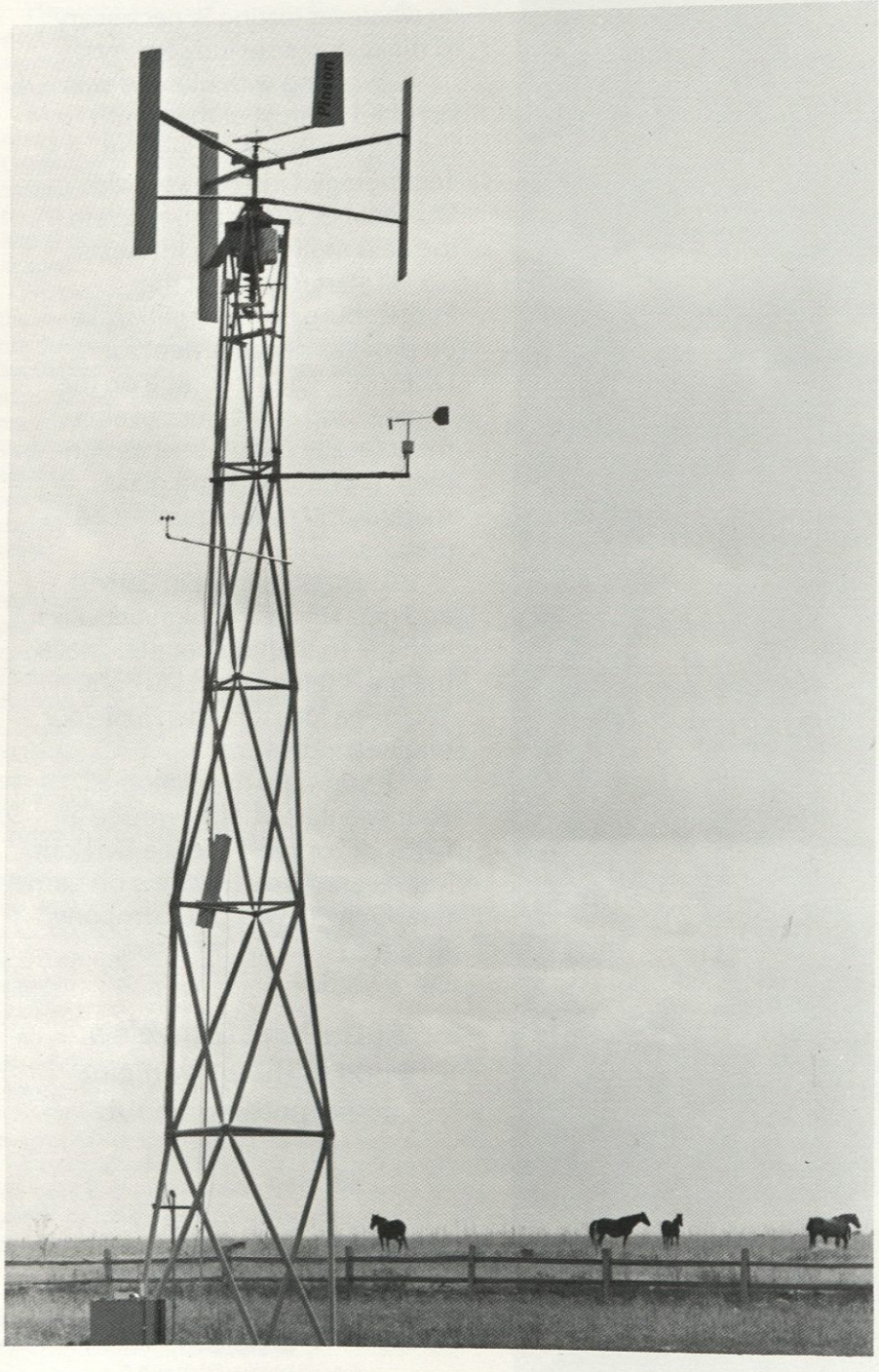


It has been estimated that the present day availability of wind resources is 2 x 10^{13} Watts.[10] This amount, if utilized at only 1 percent would still provide 3 percent of the current world energy needs. This article investigates viable wind energy storage options that assist the use of wind energy as an alternative renewable energy source.

A formidable problem concerning wind energy utilization is interfacing an intermittant energy source with a market which demands continuous, 100 percent reliable energy. Specifically, peak electric demand is usually mismatched with wind generation availability[8]. This out-of-phase problem has it's seasonal variations, weekly variations and daily fluctuations. The economically viable energy storage options available to wind energy systems usually are sized for daily fluctuations with some proposals for larger installations to provide day to day energy storage capacities. The weekly and seasonal variations that occur with wind generation will have to rely on traditional alternative backup systems in order to maintain reliable, continuous energy.

In general the purpose of energy storage applied to wind energy systems is to extend the useful availability of the naturally intermittant resource. This is viewed within the industry as improving the plant factor (or

Up With Wind Energy?

Energy storage will help make wind generation a reliable source of power.

By Jeff Haberl

load factor), a term which expresses the ratio of the calculated average output to the actual measured output[3].

Historically, energy storage appears in such forms as wood, dams for retaining water, coal, and more recently petroleum and nuclear derived fuels. The renewed present-day interest in more efficient energy storage methods can be credited to the ever-increasing price of petroleum fuels. Many of the technologies currently under investigation are applications of fundamental principles, some of which even pre-date the 1859 discovery of oil in Titusville, Pennsylvania[5].

Peak electric demand is usually mismatched with wind generation availability.

Interestingly enough, the energy storage options being investigated by utility companies to ease peak generation problems are, for the most part, also applicable to wind generation systems.

The generally accepted methods of energy storage fall in to three primary classifications which are mechanical, electrical and chemical storage. Mechanical means include both kinetic (e.g. flywheels) and potential energy storage (e.g. pumped-hydro and compressed air). Electrical energy storage includes induced field potential (supermagnets) and electrostatic potential (capacitors). Finally chemical energy storage utilizes chemical compounds which release useful forms of energy under controlled conditions. These chemical energy storage methods vary from nuclear decomposition to ion exchange (batteries) or even to different forms of exothermic oxidation (combustion).[2]

The energy storage methods discussed represent options which have demonstrated both acceptable energy intensities and reasonable economic viability. This can be seen in Figure 1 which is a graphical representation of energy storage systems based of values from Jensen,[5] Eldridge,[3] and Krenz.[7]

Energy Storage Characteristics

Energy storage can be grouped into two fundamental forms of application: transportable or stationary. Selection criteria include the efficiency of the system, the energy storage density, the power density and time required for recharging, economic and environmental considerations, system life, duration of storage and number of useful cycles.[2]

The energy density of an energy storage system defines the amount of energy that can be stored in relation to the mass (KWH/Kg) or the volume (KWH/m^3) of the storage.

One commonly overlooked evaluation criteria is the direct application of wind energy, assisted by energy storage, to tasks which can be tailored to intermittant service. Some examples of this are the relocation of electrically intensive commercial processes (i.e. aluminum or fertilizer industry) or the interconnected mutual back-up of direct utility grids over a multistate region.[4]

Batteries and Fuel Cells

The two main types of batteries are called primary and secondary. Primary batteries cannot be recharged. Secondary batteries are, as would be expected, rechargeable and therefore are the main focus of energy storage applications. Both types of batteries are basically electrochemical devices which create a useful voltage potential difference across the anode and the cathode elements within the battery.

Fuel cells differ from batteries in that a battery uses internal components and a fuel

cell relies on the addition of a fuel for the ion exchange.[4] The fuel cell actually predates the battery with the first demonstration being performed by W.R. Grove in 1839. The significant advances in fuel cell applications did not occur until the 1950's when the aerospace industry developed them for space flights. One major importance of the fuel cell is the variety of different fuels that can be used including hydrogen, methanol, ammonia, hydrazine and methane.[5]

The lead-acid battery which was first demonstrated by Plante in 1859 is the most common and readily available secondary battery for wind energy storage applications. The usual applications for a lead-acid battery involve multiple shallow charge/discharge cycles. The power density and recharge characteristics of a battery are limited by the cathode/anode areas and electrolytic reaction rate. Electric vehicles which utilize lead-acid batteries must accomodate about 1 ton of battery storage and are limited in range, recharge time and by the apparent inability to have substantial braking regeneration.[9]

Two other major drawbacks of a lead-acid battery (which are not uncommon among other batteries) are the 30% charge loss/month[7] and the ceiling on large scale applications due to limited world lead supplies.[6] The lead acid battery, even with its limitations, will continue to play a dominant role in energy storage for the next 5-10 years.

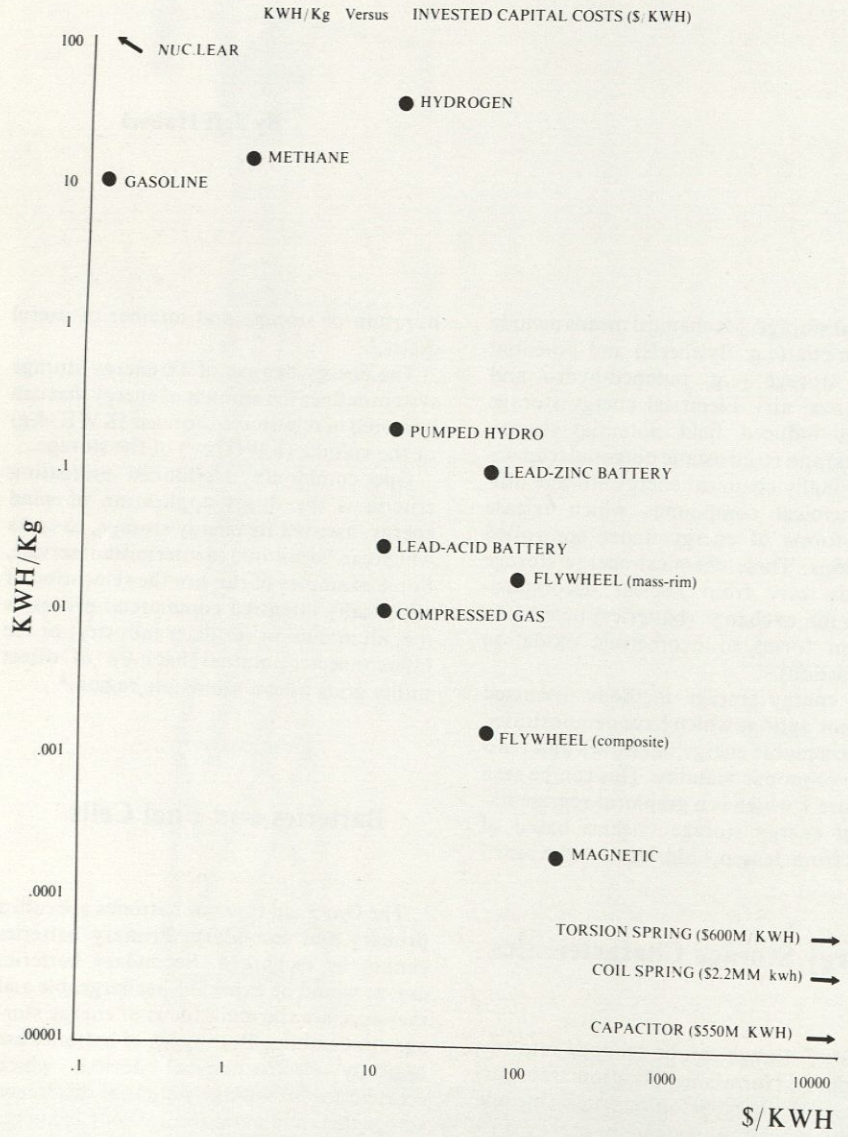


Figure 1

Another currently available battery that has demonstrated ite usefulness in industrial applications is the nickel-iron battery. The nickel-iron battery's one major advantage over the lead-acid battery is its ability to undergo numerous deep discharge cycles.[2] This is offset somewhat by the 25 percent charge loss/month (by comparison the nickel cadmium battery loses only 2 percent/month) and the relatively high cost. Neither of these limitations are considered significant enough to prevent nickel-iron batteries from being a viable energy storage option.

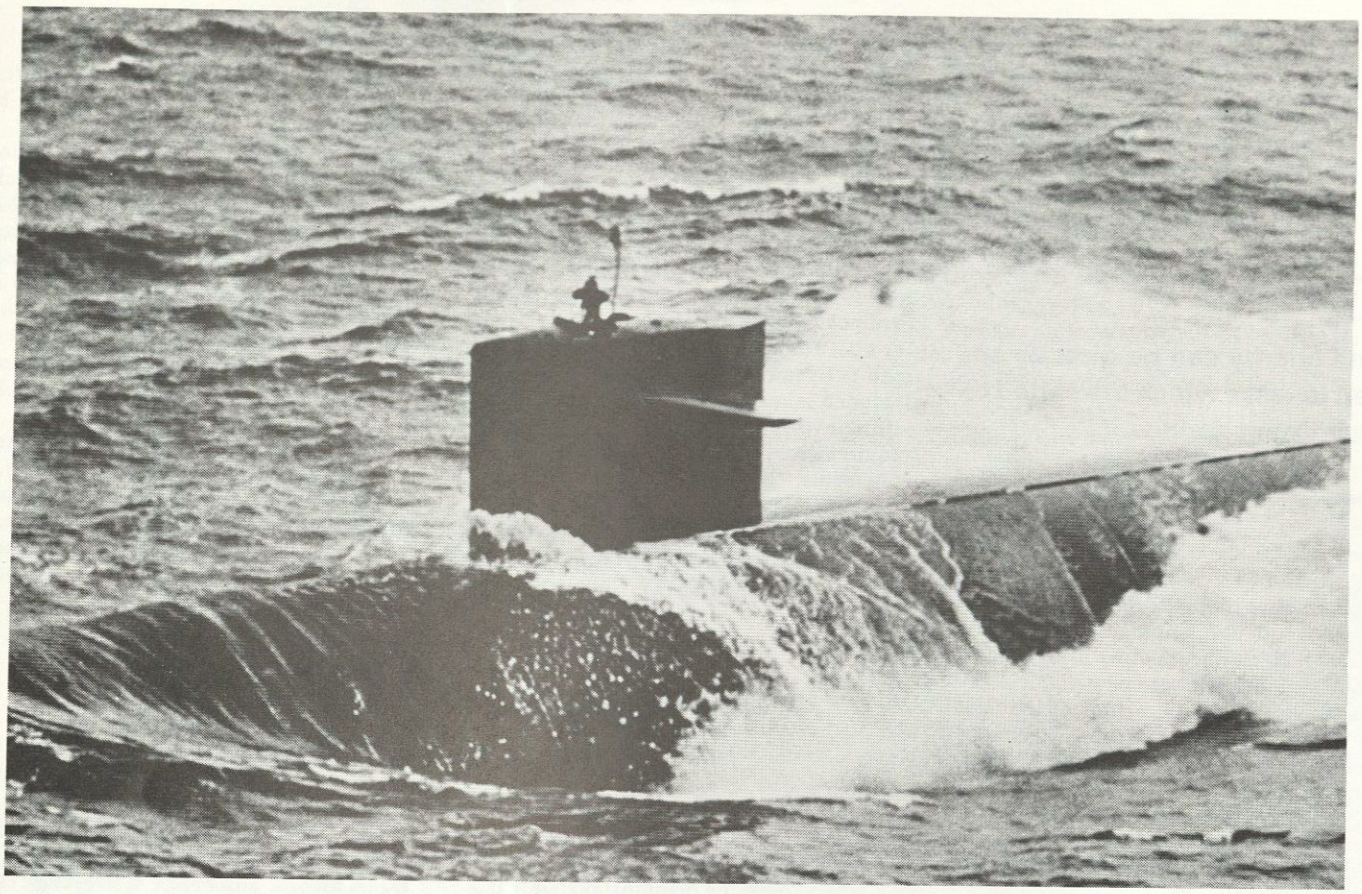
Wind generation will have to rely on traditional alternative backup systems.

The future research areas for battery storage systems involve interfacing the different characteristics of lead-acid, nickel iron and other more exotic batteries with a variety of applications including utility peak leveling, transportation, industrial and commercial applications, and isolated remote site application.[6] The different technical problems range from containment of aggressive chemical compounds to prevention of interior shorting due to dendrite growth.[2]

Pumped Hydro

The 1980 installed hydro capacity has been estimated to be 33,000 MW as compared to the 1970 installed capacity of 29,000 MW. Extensive studies have been done on dam containment losses, turbine efficiencies, evaporative losses, containment leakage during transport, etc.

The opportunity for use of pumped water as an energy storage method for wind energy generation systems (WEGS) comes from naturally occurring characteristics of hydroelectric generation. Hydro facilities operate on a similar plant factor due to the fluctuations in stream flow into the reservoir. A WEGS can displace flow through the water turbines during windy periods. Unfortunately, there are a limited number of existing hydro sites that have suitable wind energy densities. Many of the newly proposed pumped hydro storage systems are using underground caverns and abandoned mines



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in areas of high wind energy intensity.

One proposed scheme is K.H. Bergey's (Feasibility of Wind Power Generation for Central Oklahoma, Univer. of Okla., Norman Oklahoma, 1971) proposal that would use hydro during wind speeds below 6.2 m/sec, and utilize wind generation during wind speeds of 6.2-10 m/sec, with the extra capacity above that absorbed by the utility grid going into uphill pumping.[6] It is in this fashion that pumped-hydro, using underground storage, will become a viable alternative source in windy regions of the U.S. that lack above ground vertical excursions required for traditional pumped hydro. Many hurdles need to be overcome, especially the 65-75 percent efficiencies experienced to date at such sites as the Newark N.J. Underground Pumped Hydro Storage facility (UPHS)[4].

Wind energy can be directly applied to tasks which are suited to intermittant service.

Most UPHS systems would effectively store off-peak baseload and/or utilize intermittant wind energy generation and be called upon to help with peak load generation. These systems will use an upper storage reservoir at ground level, reversible turbine-/pump facility, and either existing natural subterranean caverns, abandoned mines, or newly created caverns as the lower storage reservoir. The proposed size for such a system is 200 to 2000 MWe which would provide up to 10 hours of stored generation capacity. Lower depths are targeted at 2500 feet as this accomodates readily available turbine/pump units. The construction time for a UPHS system is estimated at 14 years with 6-7 years necessary for shaft sinking. Included is an estimated 3 years worth of effort involved in satisfying governmental requirements and environmental impact statements. The targeted efficiency and price for these UPHS units is 75 percent total efficiency with 89 percent efficiency as a goal for the turbine/pump units and price estimates of $190-245 Kw.[1]

Compressed Air

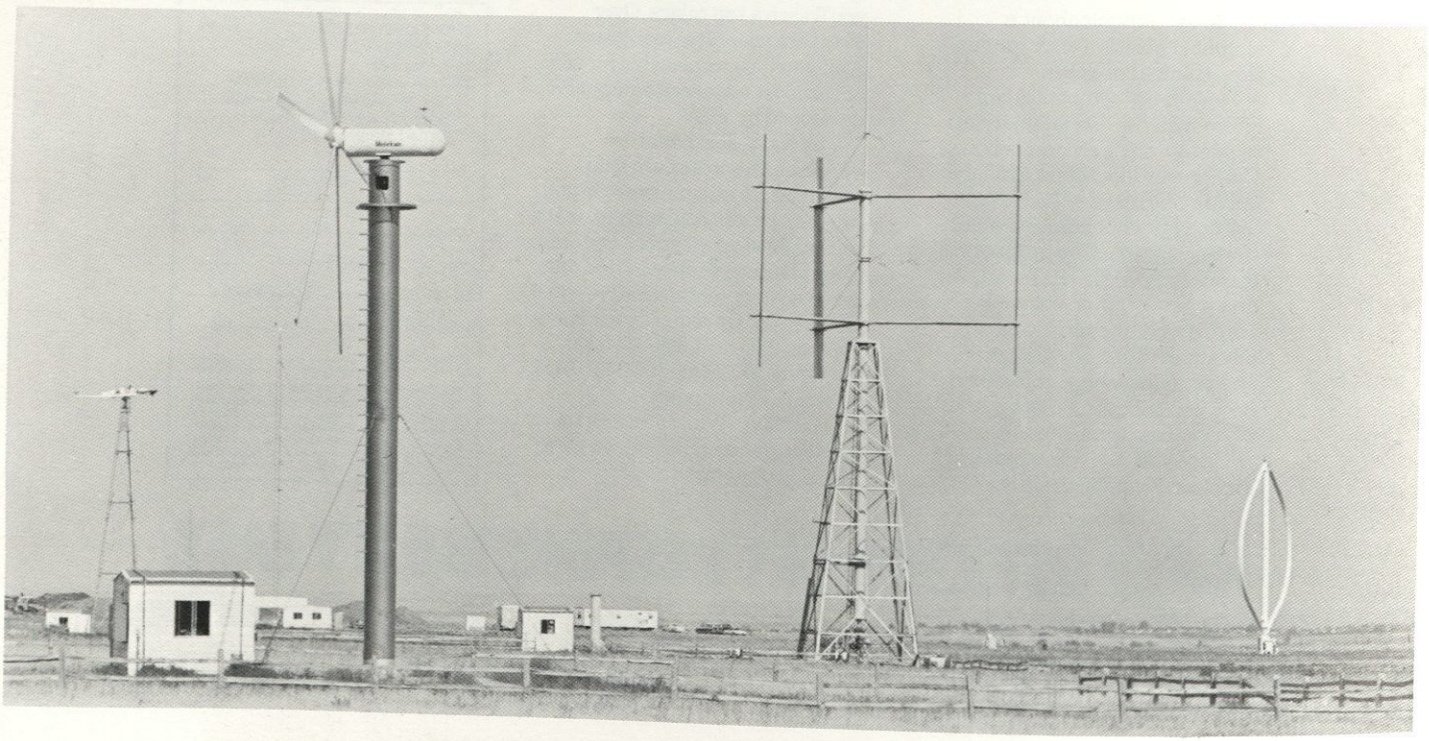
Another viable large scale energy storage system being given considerable attention is Compressed Air Energy Storage (CAES). The CAES peaking plant installed in Huntdorf West Germany (January 1979) is providing valuable field data for plants now being designed.[1] CAES systems may utilize a piston generator/compressor because of the demonstrated improved efficiency over that of a turbine compressor. The required pressure would be on the order of 12-80 atmospheres.

The advantages of a CAES application are the use of existing "off-the-shelf" technology, as well as the reduced land investment (as compared with pumped hydro). The disadvantages are: low overall efficiency (50 percent), energy loss due to the heat of compression and, storage leakage from either the reservoir or the piping. Many of the newer designs seek to incorporate a heat exchanger/preheater such as a large pebble-bed.

The cost estimates for a CAES system range from $190-263/Kw divided up as: 47 percent—power plant costs; 20 percent—underground storage costs; 13 percent escalation, 11 percent—interest; 6 percent—contingency and overhead; with 3 percent—land and well boring.[1]

Flywheels

Historically, flywheels have been used to convert impulse energy to continuous rotational torque. This can be seen in their early applications as potter's wheels and today's use in reciprocating engines. Flywheels used as energy storage for a WEGS are considered as inertial storage devices.[9] The most likely application for flywheels appears to be



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as utility daily-peak leveling units. Again, a task easily augmented by wind energy.

The kinetic energy of a flywheel is sensitive to the first power of the mass and the second power of the rotational speed and distance from the axis of rotation. This is the fundamental reason for the development of high strength, light weight composite fiber flywheels that demonstrate failure modes of low consequence (e.g. glass fibers, carbon fibers). Typically, the efficiency of flywheels is about 75 percent for the total input/output ratio.

The disadvantages of the mass metal rim flywheel are lower efficiencies, catastrophic failure, and the need for expensive high strength metals. Experience from the automotive industry shows extreme radial and circumferential stresses as well as pronounced linear stress distribution during high speed testing of rim wheels. This ultimately led to the development of anisotropic (strength in one direction) composite fiber flywheels.[8]

The new composite fibers, borrowed from the aerospace industry, have 1/4 to 1/6 the weight of steel yet demonstrate tensile strengths far greater than the strongest steels available.[9] This requires changing the traditional flywheel shapes to ones which will either accomodate wound "bare filament" flywheels, or thin rim composite flywheels with the anisotropic fibers embedded in a "glue like" composite.[8]

The advanced "superflywheels" now under development utilize "inter-fitting graded concentric rings" where the optimal weight and fiber stress are accounted for in each elemental ring.[9] Advanced flywheels still exhibit problems of application including; damaging resonant frequency vibrations, magnetic bearing problems, suitable vacuum systems (on the order of 10 microns) and large scale material availability.[1]

The proposed utility applications would involve 12 to 15 foot diameter units weighing 100 to 200 tons, and capable of maintaining 10,000 to 20,000 kWh/unit storage capacities of 3500 rpm, with 30000 kW maximum power ratings. The units are targeted to be 93 to 95 percent efficient and would carry a $325,000 price tag ($110/kW, 1972 prices).[9]

Hydrogen

The use of hydrogen as a fuel is not a new technology. Many of the storage and use applications that are being proposed for the "Hydrogen Economy" are actually revived technologies that were developed prior to the Second World War.[5] The application of hydrogen to energy storage for wind systems began to receive renewed support when Heronumuis proposed offshore systems that utilize hydrogen for fuel storage in 1972. One of the selling points for hydrogen is its advantage over electrical transmission in terms of investment capital costs and somewhat more benign environmental consequences.[5]

The proposed applications of stored hydrogen include fuel cells, gas turbine combustion, and general heating use in existing utility gas lines.[4] Different methods include storage as a liquid, gas or in combination with a host material as a metal hydride. The various methods of production include: "catalytic steam reforming", partial oxidation of heavy oils, water-gas reactions, biochemical production, and finally electrolytic decomposition of water.[5] The last process seems to lend itself well to wind energy utilization providing there are adequate supplies of water available for decomposition.

It is apparent that many energy storage technologies can be used for wind energy storage. The particular criteria used to choose a system depends on the individual application.

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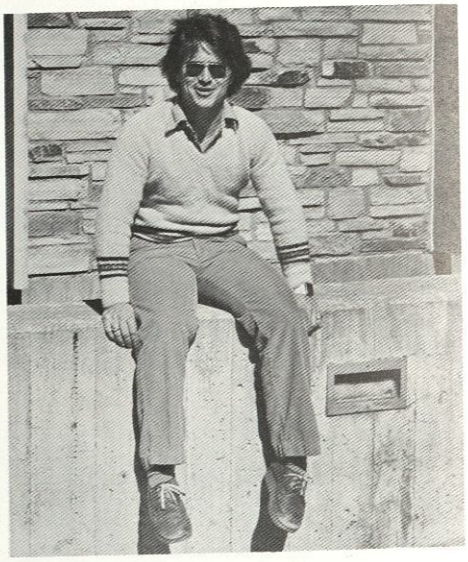

We asked Jeff for a thirty or so word blurb about himself, and this is what he turned in: blurb blurb blurb blurb blurb . . .

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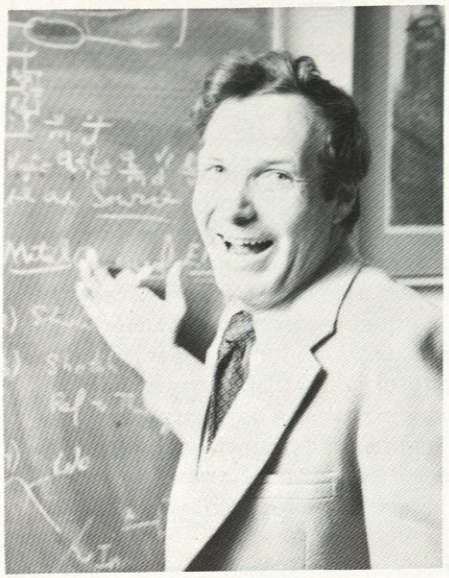


Professor Barnes Takes on Role of Acting Dean of the College of Engineering

By Ellice Kay Goldberg

The engineering school is "ready to turn the corner" says Professor Frank Barnes, Acting Dean of the engineering college. While the engineering school is searching for a new Dean to replace William J. Pietenpol, who recently resigned to work in industry, the *Colorado Engineer* took the opportunity to interview the man presently on top, Professor Frank S. Barnes. Barnes is an excellent man for the job considering all of his credentials.

He received his B.S. at Princeton University in 1954, Masters at Stanford University in 1955, and Ph.D. from Stanford University in 1958, all in Electrical Engineering. He has published 81 articles, and written one book. He has worked at the National Bureau of Standards, and Colorado Research Corporation. Professor Barnes came to the University in 1959, after he had been a Professor in Baghdad, Iraq for a year. He has been chairman of the Electrical Engineering department since 1964, and attained his professorship in 1965.

His list of honors, awards and activities are quite impressive. He has been involved in many professional activities. He is a member of Sigma Psi, American Physical Society, American Association for the Advancement of Science, Institute of Electrical and Electronics Engineers, Eta Kappa Nu (electrical engineering), Tau Beta Pi, and the Council of Thrombosis of the American Heart Association. Combine these credentials with a warm friendly personality, and it is no wonder he is acting as Dean of the engineering college.

Even though Professor Barnes is acting as Dean, he still is teaching a course in electronics, and is involved in three fascinating projects. He is busy working on a solar energy project for SERI with Professor Gage measuring the resistance of a thin film of semiconductors on metal substrates. He is also working with Howard Wachtel, C.L. Hu and R. Igor Gamow, trying to understand the effects of microwave and radio frequency radiation on biological materials. Lastly he is working with the C.U. medical center to develop an acoustic drill which breaks up gall stones.

The Dean feels the engineering college is presently on an upswing after being hurt by the tight budgets. He feels that the recent moves by the administration are encouraging. The administration is presently trying to improve the teacher to student ratio by hiring a number of new faculty; Dean Barnes is optimistic about the situation. "The moods in the country are changing," said the acting Dean. "People are no longer worrying only about how many tax dollars are spent, but what they are getting for them. The public is beginning to realize the importance of higher education and high technology to the economy and to their welfare."

Since there is such a demand for admission to the Engineering College, it can be more selective in choosing students that it has been in the past. Last year there were over 2000 applications for 450 seats. The Dean is very encouraged by this demand, and he is trying to make it possible for more students to get into the Engineering College. The caliber of students has steadily risen in the last four years, and the academic failure rate is only about 5%. Though there is no problem in getting students, there is a problem trying to maintain the number of faculty.

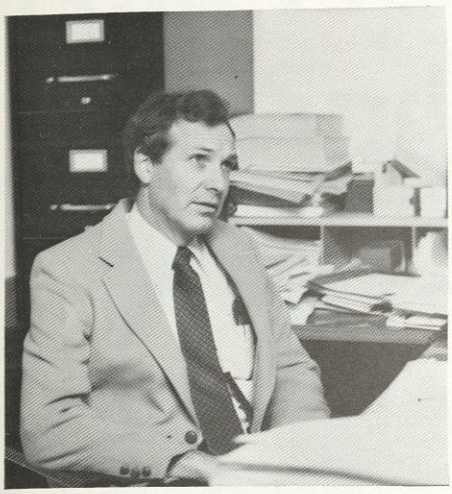
"The University of Colorado does not pay their faculty enough to be competitive with other excellent universities. We've lost some good people because of the salary situation," said Professor Barnes. He still looks forward to his job and hopes that the JBC and the university administration will improve the situation.

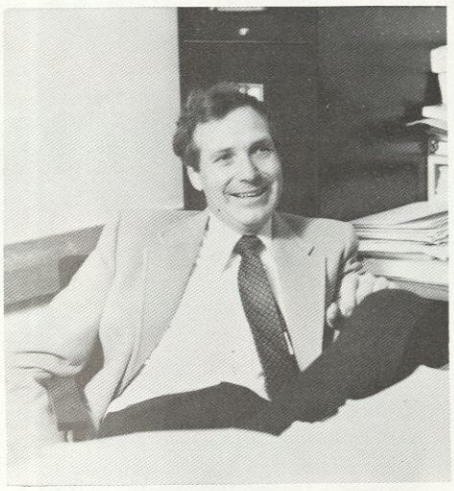
We asked Professor Barnes if the financial problem will have some bearing on who we could get to replace the Dean. He felt it would have an effect, but hoped it would not be controlling.

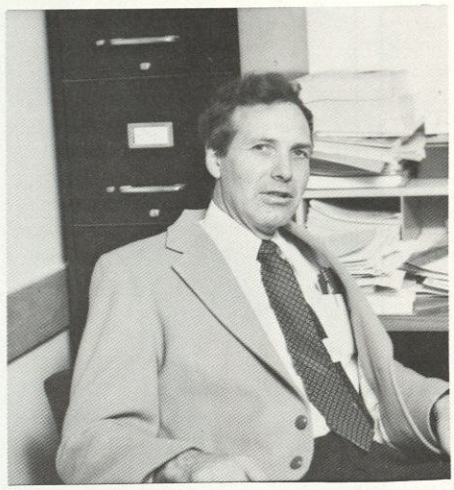
The acting Dean is still proud of the Engineering College. He described it as being "one of the better state schools." (The College of Engineering was recently ranked 11th in the nation by a survey of the number of faculty cited in *Who's Who in Engineering).* When he was asked if the JBC has lowered the quality of education in engineering he said that "the college still has a lot of potential if we get the resources to capitalize on our opportunities."

Professor Barnes intends to work on the

the Top



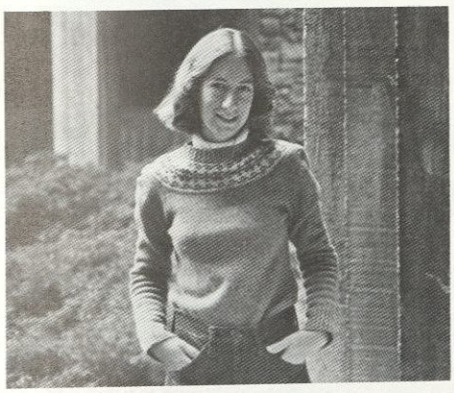




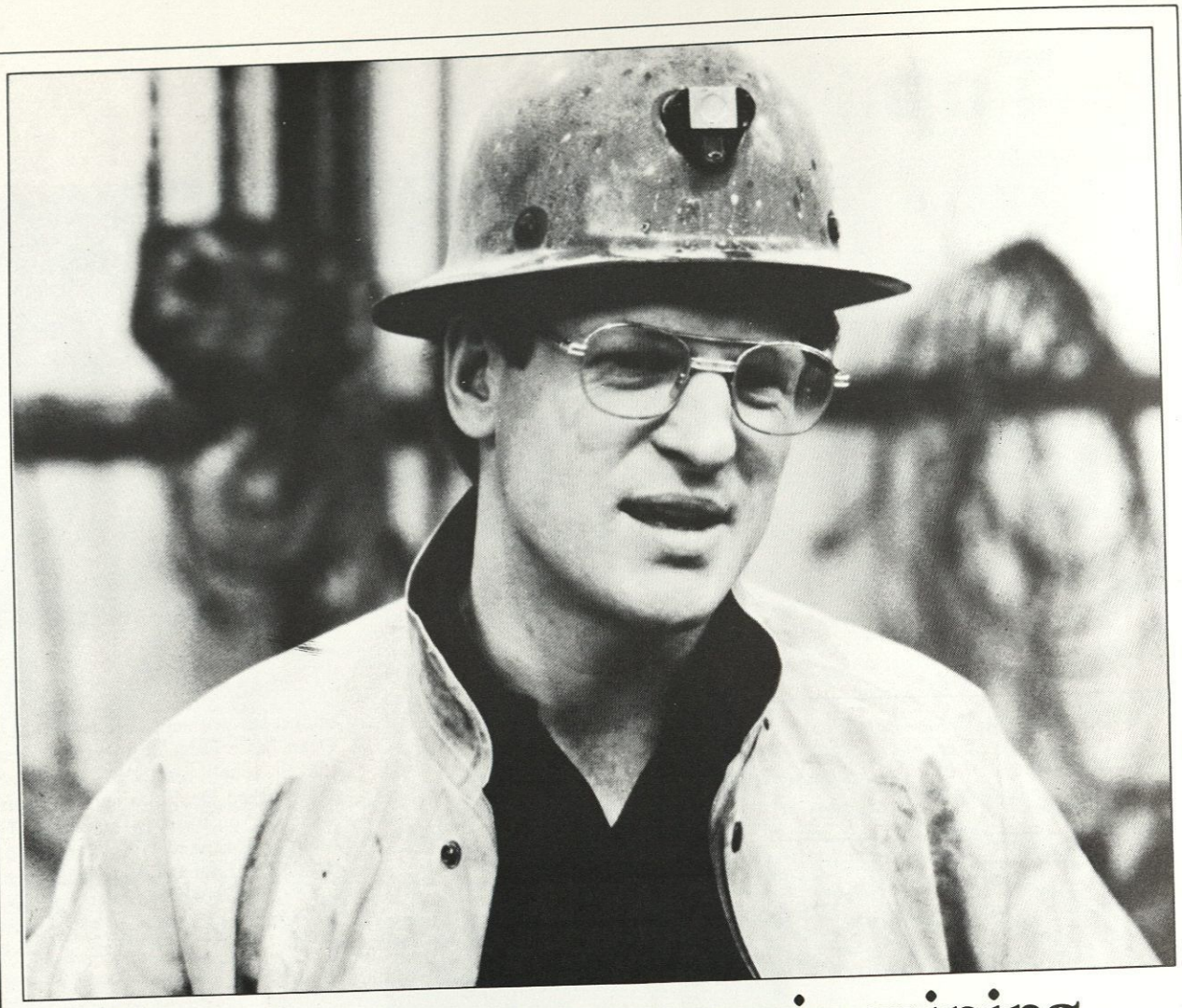
". . . The college still has a lot of potential. . . ."

budget cut problems. He feels that the new Dean has a great opportunity ahead, and that the school is only going to improve.

We asked Dean Barnes if he would consider the position permanently if it was offered. He replied, "it is too early to answer that." The Engineering College has a good future, and whoever replaces Dean Pietenpol permanently has an interesting challenge ahead.



Ellice is presently a senior in Chemical Engineering. She is active in AICHE, SWE, the Biomedical Engineering Society (currently vice president), AED (currently historian), and her synagogue. She plans to go on to medical school next year. She enjoys running, swimming, racketball, and skating, and in her spare time plays the guitar, and goes backpacking. She is also working as a volunteer at the Peoples Clinic.



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And Now a Word From Our Sponsor

All about the Associated Engineering Students

By Marty Ida and Mark Lee

If every member of the Associated Engineering Students paid $1.50 in dues, the organization would have $3496 per year to play around with. That's quite a lot of calculator batteries.

The truth of the matter is, each member does pay $1.50; knowingly or unknowlingly, through his or her student fees.

AES is the official organization of the students of the College of Engineering. The governing body of AES plans and executes all activities appropriate to the interests and traditions of the College of Engineering. They coordinate the honoraries and professional engineering societies on campus, along with supervising the posting regulations within the engineering center.

If you are in need of a tutor, the AES office (OT1-6) is a good place to start. AES gathers information on tutors and those in need of tutoring and tries to pair them up. They also are responsible for running tours of the Engineering Center in cooperation with the Administration.

Every spring, AES sponsors its annual Engineering Days festivities. Last year's E-Days featured an Engineer's Ball, an all-college picnic, concrete canoe races, mud volleyball, a pie-eating contest, paper airplane contest, an egg drop (from 5½ stories!), a tug-of-war, slow bicycle race, mousetrap race, balloon rides, professor dunking, and a multitude of athletic competitions.

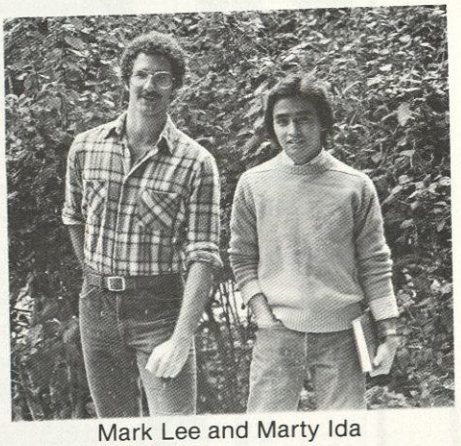
AES Fall activities included the Engineering School F.A.C. in the month of October. The group also co-sponsored a number of movies with other societies. On the more professional side, AES will hold several Brown Bag seminars in which guest speakers will be brought into the school to lecture on topics ranging from solar energy to engineering management. They also will sponsor a letter to the Colorado legislature telling the legislature how the students feel about recent legislative actions concerning the College of Engineering. Other possible AES activities include dinners, a winter cook-out, acquisition of new furniture for the Real McCoy Lounge, and fund raising for Folsom Park.

Marty Ida, the president of AES, is responsible for the overall operation of the organization and oversees the Control Board (the legislative body of AES). He along with the other officers make up the executive council which makes all the critical decisions concerning fiscal policy.

There are two vice-presidents within AES. Laurie Burke is in charge of coordinating the honoraries and societies and works with the commissioners in charge of tutoring, tours, and elections. She also assists the president in all activities sponsored by AES.

Mark Lee is the other vice-president, and his main responsibility is serving as the Engineering School Representative on the Executive Council of UCSU. Lee works with the budget AES gets from student fees and tries to voice the concerns of the engineering students to the executive council of UCSU. He also works with the other AES officers on planned activities.

AES meets at least once a month to discuss and plan its activities. Notices of meeting time and place are sent to all societies and are also posted on the light board in the main lobby of the Engineering Center. These meetings are open to the public, so any student with ideas or the desire to get involved is encouraged to attend.



Mark Lee and Marty Ida

Concrete canoe race '79

photo by Robert A. Christopher

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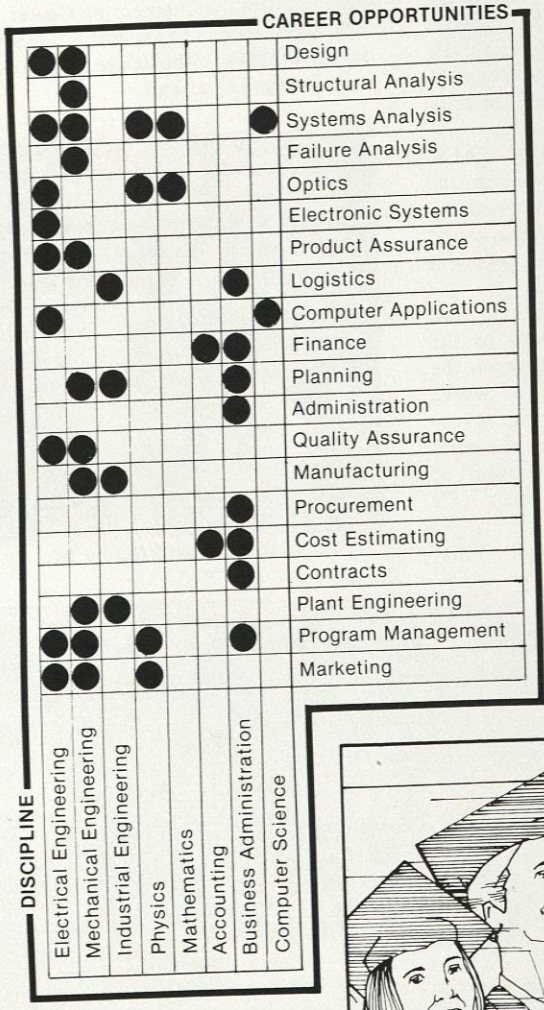

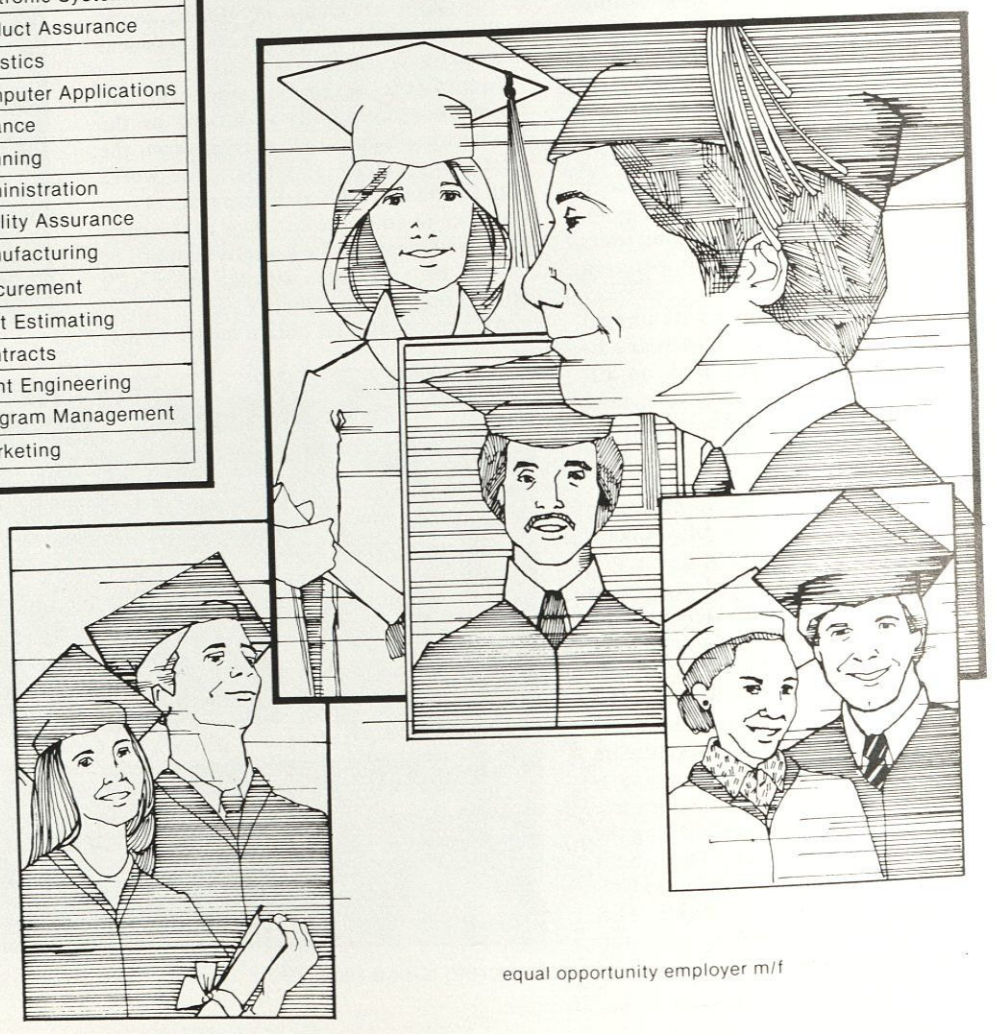

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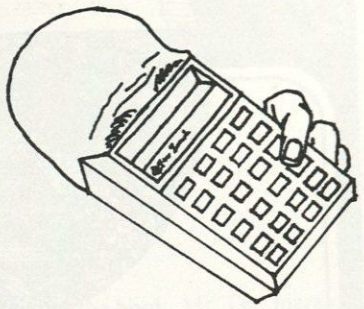
CALCULATOR UPDATE

by Kiyoshi Akima



UNSUPPORTED FEATURES

Lubarsky's Law of Cybernetic Entomology:
There's always one more bug.

No matter how hard the designers and microprogrammers try, the final product is seldom *exactly* what they wanted. A few unwanted features slip by, making the calculator slightly different from the manufacturer's definitions. These "unsupported features" can often make a calculator much more powerful than intended. They can add additional functions to the calculator, and in some cases open up whole new dimensions in calculating.

Perhaps the most famous, and certainly one of the earliest, is the timer on the Hewlett-Packard HP-45. This stopwatch can store nine splits as well as the last time it was stopped, and reads in hours, minutes, seconds or in hours, minutes, seconds, and centiseconds. Although the timer is about ten percent slow, it can be made accurate simply by adding a 784 kHz crystal. The multiple key pressing used as one method for calling the timer is [RCL] followed by [CHS, 7, 8] simultaneously. [CHS] starts and stops the timer. The technique of multiple key pressing is a common method for calling unsupported features and also can give considerable insight into the internal workings of calculators.

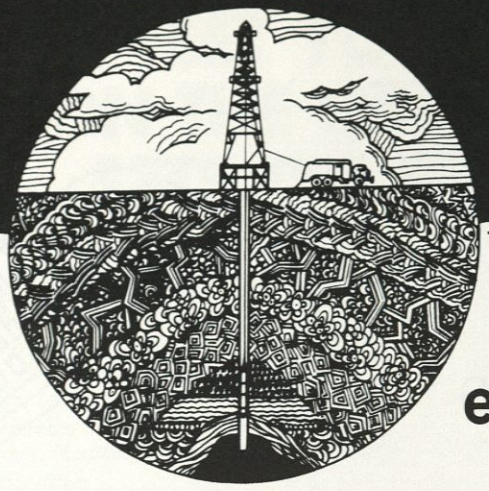
Texas Instruments' first programmable calculator, the SR-52, has some phantom registers which are not described in the owner's manual. The program memory can be accessed through these registers, allowing the user to write self-modifying programs. Similar features are available (and undescribed) for their newer TI-58, -58C, and -59, as well as the HP-41C.

The TI-58, -58C, and -59 also allow the user to directly address the operations stack. The user can change the operators and operands, insert and delete elements, and rearrange their order. This is done through the use of Op-code 82, which gives the mnemonic HIR when used with the PC-100A printer. This unsupported Op-code can be created by entering [STO 82] in program memory and then deleting the [STO]. HIR is a two instruction sequence. For example, executing the instructions [82 03 82 15] stores the display in stack register 3 and then recalls stack register 5. One can experiment to find the effects of other operands.

The HP-67 has a limited alphabetic capability. Being a hexadecimal (base 16) machine, six characters are available in addition to the digits. Using these characters messages can be shown on the display, or even scrolled across it marquee-style. These graphics are created by putting the program pointer into the secondary data registers. Also, data register 0 can be executed as a program instruction.

Perhaps the greatest potential lies with the synthetic programming capabilities of the HP-41C. Synthetic programming allows access to features and functions which (supposedly) are not on the calculator. Some of the possibilities include storing program steps as data, putting the program pointer inside multibyte instructions, and setting higher-numbered flags. The status register and the cold-start constant are also accessible to the user through synthetic programming. Synthetic programming is still being explored, and promises an exciting new dimension in the use of this new calculating system.

This article is only an overview of the more common and easily used of the unsupported features. For more detail regarding these and other features of pocket calculators, stop by the *Colorado Engineer* office and we'll be glad to discuss them with you.



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Book Review

By Bruce Murphy

Handbook of Architectural Details for Commercial Buildings

Joseph De Chiara
McGraw-Hill Inc.
New York, 1979.
508 pages
$32.50

Welcome back to another semester of academics! For all of those who spent the summer meticulously detailing working drawings, McGraw-Hill has a new book for you. Think of the time you might have saved if you had been able to locate that fireplace design for the local country club, the optimal floor plan for your favorite dentist, or the best placement for your company's jobsite signs.

Mr. Joseph DeChiara has prepared over 500 pages of actual drawings submitted by architects from across the country. The *Handbook of Architectural Details for Commercial Buildings* is divided into two parts. The first part includes plans, elevations, and sections. Each of the chapters cover a specific class of building construction: office complexes, warehouses, shopping centers, etc. Part two presents the individual detailing in connection with each type of building. Each chapter graphically describes the detailing of such things as stairways, interiors, and entrances.

In preparing *Handbook of Architectural Details,* the author set out to accomplish three major things: to help architects avoid duplication of effort, to present new designs and to give solutions to common problems.

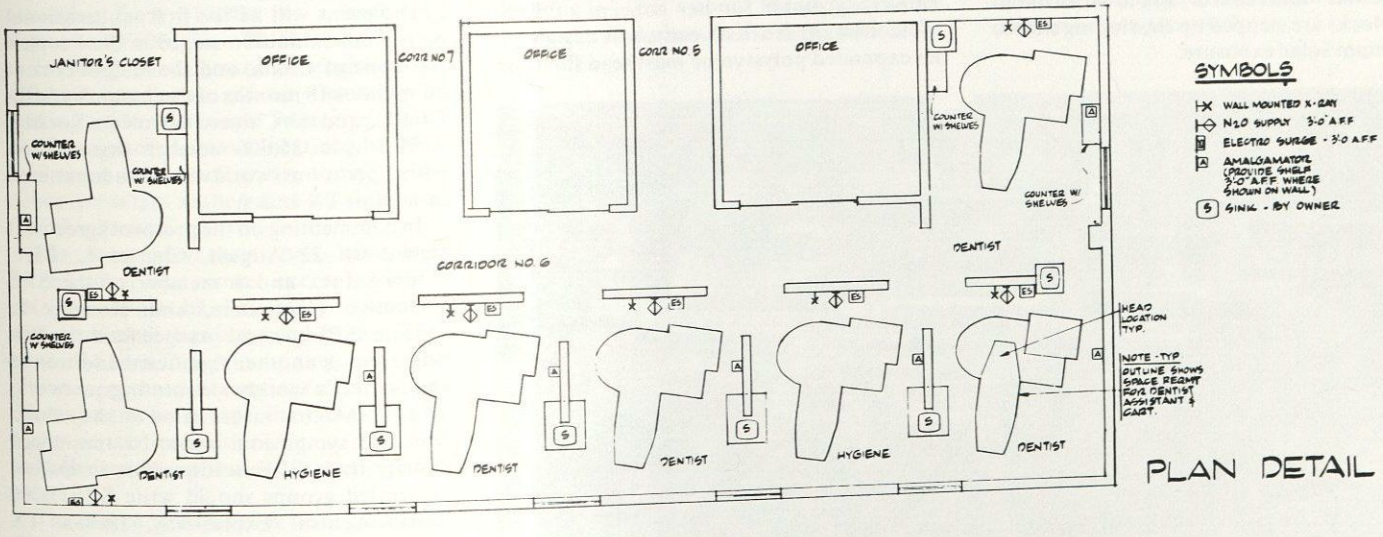
During the preparation of the book, Mr. DeChiara discovered a large amount of repetitive work among the architectural drawings. By combining collections of similar drawings, he gives the architect-/designer access to the most common forms of detailed drawings, which can then be used as a reference.

New building designs are continually being created. Many of the drawings represent state-of-the-art buildings. By placing these drawings in the book, the author has proven that many buildings thought to be impossible to draw can be drawn. The collection of drawings were chosen not just for their unique design qualities, but also for their clarity, quality, and draftsmanship. (Note: our copy of the book contained many drawings that had been obscured by poor printing and excessive reductions).

All architects have at one time been confronted by simple design problems that they couldn't readily solve. The author has attempted to define the most frequently encountered problems and incorporate their solutions into the book. By examining graphic displays of window frame detailing, for example, the architect can see just how to design his windows.

A word of caution for those that will want to go out and purchase *Handbook of Architectural Details:* state and local building codes vary from region to region. Care should be exercised when adapting a particular drawing to your building design. This book is intended to be used as reference manual.

Ultimately, you should find a wealth of information between the covers that shouldn't be overlooked.



Project: Dental Building for Hockanum Valley Associates; Manchester, Conn.
Architect: Frank J. Stiene; Union, N.J.

News News

A NEW HOME FOR SERI

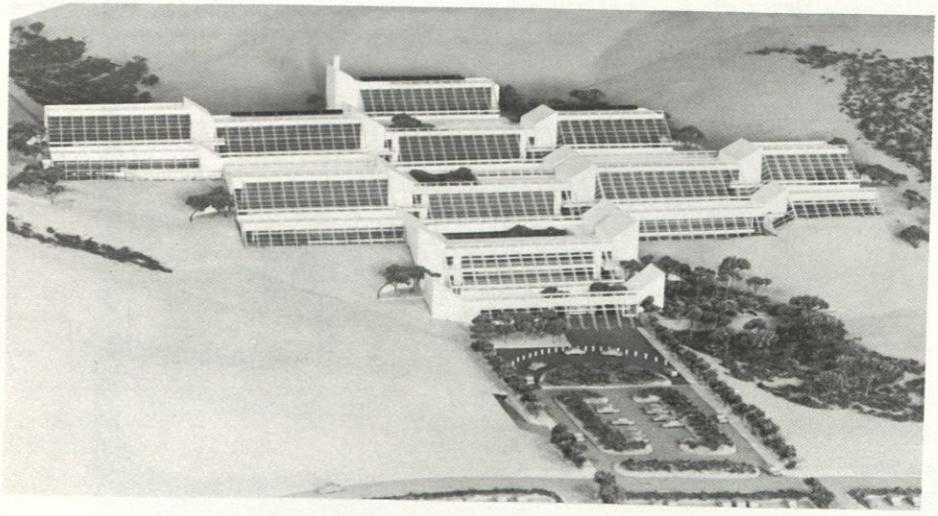
DENVER—Last year, when Table Mountain Architects/Engineers, a multi-discipline design team, presented their initial concept of the Solar Energy Research Institute's permanent facilities to SERI and Department of Energy officials, they were supported by a 5 X 8 foot, 1/32 inch scale model of the project built by Denver's Condit Exhibits.

This summer, after a year of refinement and budget-related adjustments, the Table Mountain group has gone before DOE and SERI with a final presentation, aided again by a Condit Exhibits architectural model, this one in considerably greater detail at twice the scale.

A number of "alternative" renewable resource energy systems—wind, biomass, photovoltaic, etc.—are combined in the design to make the facilities a solar showcase: 80% energy self-sufficient.

But the most dramatic energy gains are through passive systems. Situated in a bowl on the southern slope of South Table Mountain, a mesa in the foothills West of Denver, the facilities are sheltered from wind and open to sun throughout the year. Greenhouse-like "solar courts" and low-rise building blocks are stepped up the sloping site for optimum solar exposure.

The model is at SERI's interim headquarters where it will now serve public relations purposes and similar extended use through photographs.



POLYSTYRENE—GOOD AS GOLD.

DES PLAINES—College and university students may win up to $1,000 in Scholarship Awards by coming up with an original and practical idea based on the use of polystyrene foam. The Fourth Annual EPS Scholarship Awards Competition, sponsored by the Expanded Polystyrene Division of The Society of the Plastics Industry, challenges inventive minds to design workable, worthwhile new products using expanded polystyrene as an important element.

The EPS Scholarship Awards Competition offers three cash prizes—$1,000 First Award, $500 Second Award, and $200 Third Award. Honorable Mention plaques are given for Fourth and Fifth runners-up.

In the 1980 competition, the $1,000 top award went to a Southern Massachusetts University junior for her concept of EPS molded board as artist's canvas. A design for an expanded polystyrene masthead float for catamarans (sailboats with twin hulls) earned a MacMurray College senior the $200 Scholarship Award.

A brochure describing the contest requirements, and including a preliminary entry form, is available at the Colorado Engineer office or by writing to: The Society of the Plastics Industry, 3150 Des Plaines Avenue, Des Plaines, IL 60018.

Preliminary entry forms are due December 1 and the competition will be judged during the Expanded Polystyrene Division Annual Conference March 5, 1981.

PETROLEUM ENGINEERS HEAD EAST

BEIJING—The Society of Petroleum Engineers (SPE) and the Chinese Council for Promotion of International Trade (CCPIT) announced plans for an SPE international petroleum exhibition and technical symposium to be staged in Beijing in March 1982. Preliminary plans call for some 20,000 net square meters of space and a technical program of 70 papers.

The event will be the first multinational petroleum exhibition staged in the People's Republic of China, and the announcement culminates 18 months of discussion by SPE, CCPIT, and the Chinese Petroleum Society.

SPE is a 36,000-member organization with operations worldwide, headquartered in Dallas, TX U.S.A.

In commenting on the protocol agreement signed on 22 August, Charles L. Bare, Conoco Inc., and a member of the SPE Executive Committee, and Douglas L. Ducate, SPE general manger, said the Beijing event is another significant addition to the Society's worldwide meetings network. Ducate said that information on the exhibition and symposium would be announced shortly from SPE headquarters in Dallas. Interested groups should write SPE, 6200 North Central Expressway, Dallas, TX 75206, U.S.A.

Donald G. Rusell, vice-president of exploration and production for Shell Oil Co. in Houston, is program chairman for the

technical symposium, which is expected to include speakers from throughout the world's oil-producing areas. Chinese petroleum engineers are also expected to participate in the program.

EE DEGREE PAYS OFF FOR THE CLASS OF '80

NEW YORK—Despite a declining economy, the demand for electrical engineering graduates has never been stronger, reports ELECTRONICS magazine. According to the McGraw-Hill publication, more companies have been recruiting for more engineers than ever before, with the inevitable result that, in some instances, salary offers have been 15 to 20 percent above last year's.

Figures put out by College Placement Inc. show overall engineering hirings are expected to increase 26 percent at the bachelor's level over 1979, 22 percent at the master's level, and 57 percent at the doctoral level. ELECTRONICS reports that salaries for electrical engineers in the class of '80 are averaging from $19,000 for a bachelor's degree to $30,000 for a Ph.D.

The heightened demand for engineers has afforded graduates greater flexibility in making career decisions. Many graduates indicate factors such as location, benefits, and career opportunities are taking precedence ove salary as the prime consideration for job selection.

The companies themselves have been forced to recruit more intensely, selling career growth as hard as salary to students who want more than just good money. They have also been forced to employ innovative recruiting techniques ranging from wine and cheese parties for prospective candidates, to nights on the town with company personnel to showcase the attributes of the company's locale.

The fierce competition for graduates, ELECTRONICS notes, is likely to be a reality for years to come. As a career advisor at the University of California at Berkeley told the magazine, "We've had so many companies recruiting that there aren't enough students to go around."

WHAT HAS 4-WHEELS AND GOES RING-RING, HMMMM . . .

PONTIAC, MI—As part of the U.S. Department of Energy demonstration project with American Telephone and Telegraph Company, GMC Truck & Coach Division has announced it has delivered 15 electric-powered vans to Michigan Bell in Detroit.

Donald A. Ziemer, GMC's chief engineer for electric vehicles, said test data derived from the electric vans in Michigan Bell service will help GMC considerably in its efforts to put battery-powered commercial vans into production later in the 1980s.

"We currently have 20 electric vans in AT & T service in Southern California as part of this federal Department of Energy feasibility program and the vans are performing satisfactorily," Ziemer said.

"They fit in well with Pacific Telephone's short range use—from 15 to 20 miles a day," he added. "That's about the same distance Michigan Bell plans to drive the vehicles."

Michigan Bell, like Pacific Telephone Company in Culver City, California, will use the electric vans for regular telephone installation and repair operations.

"Powered by 36 Delco lead-acid batteries, these vans have an urban range of 40 miles and a top speed of 50 miles per hour," Ziemer pointed out. "With those two major exceptions, the GMC electric van's performance is generally comparable to our conventional gasoline-powered van."

The batteries are stored under the van floor for maximum interior space. The battery pack mounting installation is designed to make charging and maintenance operations easier.

"GM's previously announced zinc-nickel oxide battery breakthrough is important to GMC Truck & Coach, which is responsible for battery-powered van development within General Motors," Ziemer said. "This battery would extend the range of GMC's electric vans to about 100 miles.

"In addition to contributing to the development of battery technology," Ziemer said, "Our electric van feasibility tests in California and in Detroit provide on-the-road experience with other components that must be proven before electric vehicles can go into production. These include motors, speed controllers, charging equipment and other drivetrain components."

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THE HONORARY SOCIETY OF LUBRICATION ENGINEERING

Lubricity shall lack no champion . . .
Friction shall not thrive unopposed

The Oil Can Society first appeared around 1916. The crest was commissioned by a student named A.F. Lyster that year. It originally read "TO HELL WITH FRICTION" but it was modified slightly for fear of incuring the wrath of the powers that be (or were). Membership in this fraternal organization is gained by committing some blunder or boo-boo of note (preferably within the realm of the Engineering College) or other wise contributing to the fight against friction in daily life. Nominations to the society are published in the COLORADO ENGINEER. The oil can feature was last regularly published in 1957 but we have revived it here and hope to see it become a thriving brotherhood once again. The following sample represents some of the better qualifying acts by past members of the society.

Thomas Titley was elected to membership when it was learned that he had spent several hours at the simple problem of converting degrees centigrade to radians. *—1917*
This item from one of the society's first members has been reprinted at least 3 different times.

First prize for the answer to "how long is a line?" goes to the youth, whose name was not divulged, who insisted that the length varies directly as the distance between the two ends. *—1917*

A freshman engineer, after racking his brain for hours, conceived a combination of five things taken six at a time; a deed present day freshmen will have a hard time topping. *—1923*

Ottenheimer asked a professor to explain what is meant by the resistance, reactance, and impudence of a circuit. The impudence of a circuit is measured by placing an ammeter across the line and reading the time limit inverse hyperbolic function of the scale reading. *—1925*

Our editor, Al Thomas, is at last a noted member of the society. He has recently made a brilliant discovery. He has found that a switch board makes an admirable writing desk. However, Al has found one difficulty with the new application. The terminals of a certain 220-volt switch don't seem to be able to get along at all with Al's aluminum clip board. In fact, they even went so far as to bite a huge hole in the board when he was trying to write. Al has about decided to get a wooden board, which he has heard is much more congenial with 220-volt terminals. *—1927*

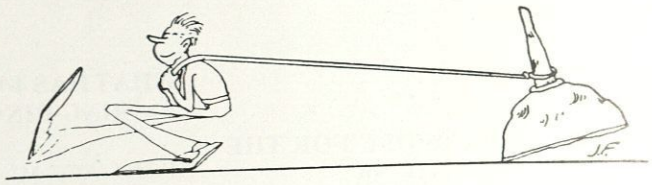
John McKinley, junior chemical stated in Materials Testing Lab that most specimens got hot when they begin to neck. *—1928*

Cris Bartlett took hold of two terminals in the A.C. Lab to see if they were hot. They were. *—1928*

Paul Turnure discovered that an induction motor that had just been received at the University had been shipped with the torque missing. The important accessory was immediately rushed from the factory. *—1928*

Warren Dowler, a Ch. E., was asked the length of a one-half inch steel rod that would break if suspended from one end. The answer proved the rod to be about four miles long. Warren, very conscientiously asked, "Is this a theoretical rod that we're working with?" *—1952*

Bob Pottington, a junior, wants to know if the speed of a motor is measured in rpm per second or rpm per minute. *—1952*



The Oil Can Society also published jokes particularly in the 1940's, such as this choice example.

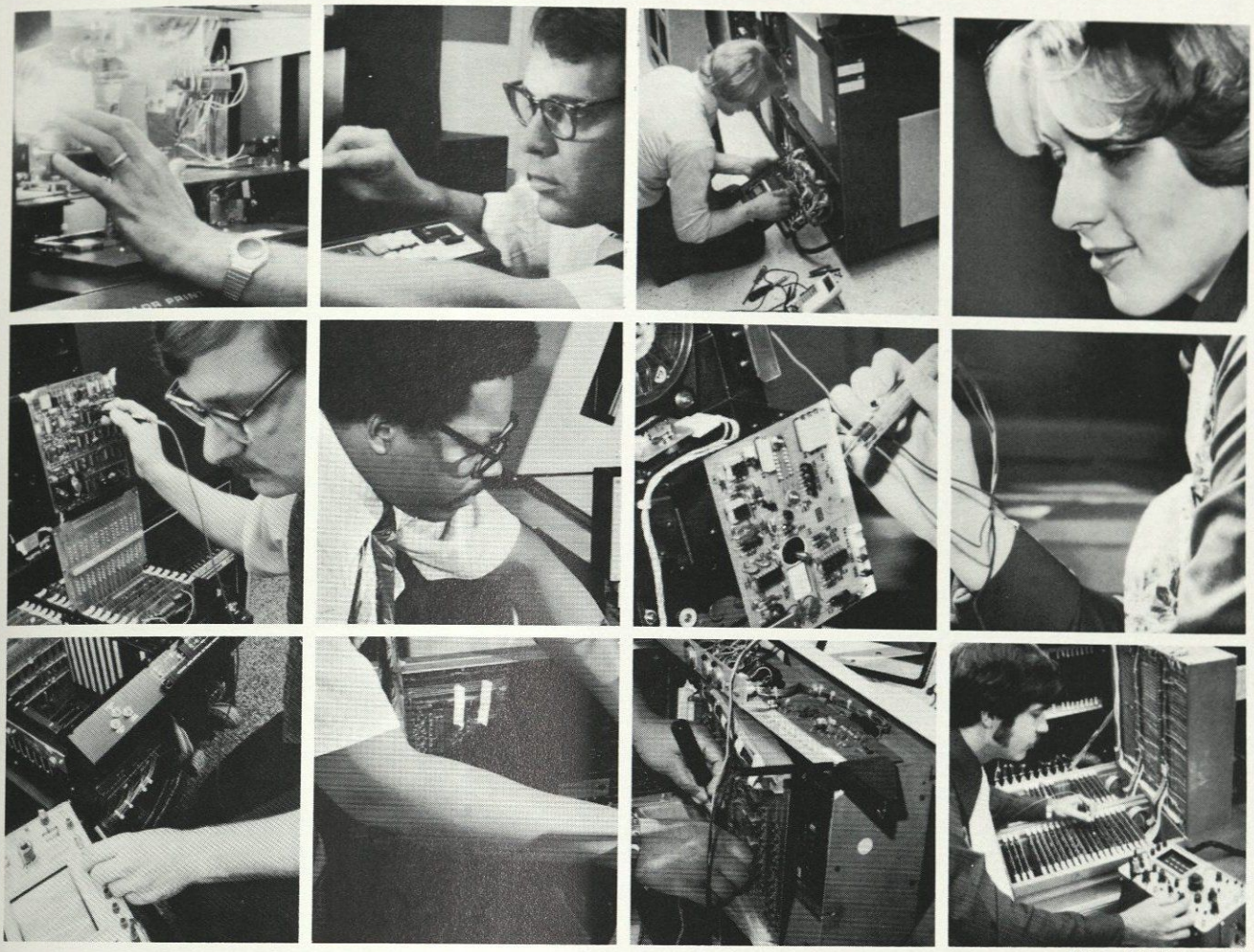
WHY ARE FIRE ENGINES RED?
Well, they are operated by pedals with the feet.
A foot is twelve inches long.
Twelve inches is a ruler.
Queen Mary was a ruler.
Queen Mary was a ship, too.
Ships travel on water.
Fishes live in the water and fish have fins.
The Russians live next to the Finns.
The Russians are reds.
Fire engines are always rushin', so—
They must be red, too; see?
—1942

Finally, we come to this month's new nominations for membership. A quart each of long life synthetic super-oil to these C.E. (Comical Engineer) faculty for their work in lubricity.

Professor Haddon who often kept his EE 453 class informed with bits of wisdom on the blackboard such as:
"Assembly language programming is like trying to draw a copious flow of water from a stone all day long, only harder."
or ". . . like a refreshing bath in pig swill."
And the philosophical: Programito, Ergo Sum.

Professor C.T.A. Johnk is nominated for punishing his class with: "Please take a ditto, not a dahto. (Morse code anyone?)
and (on the subject of Laplace transforms) "isn't that what Brigham Young said when he got to Salt Lake City, 'ces't la place'?"

In order to keep the society from again disappearing like blue smoke out the tail pipe, new members will have to be elected often. Bring or send your nominations to the COLORADO ENGINEER office (ECOT 1-8). Any reasonable providers of anecdotes or perpetrators of blunders will be given careful consideration for this prestigious award.



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The electric car you see here is one of a pair of experimental vehicles GE is developing for the Department of Energy.

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What's made this big difference is electronics. A GE-designed microcomputer manages energy flow throughout the propulsion system, regulating power demand to extend the car's range.

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