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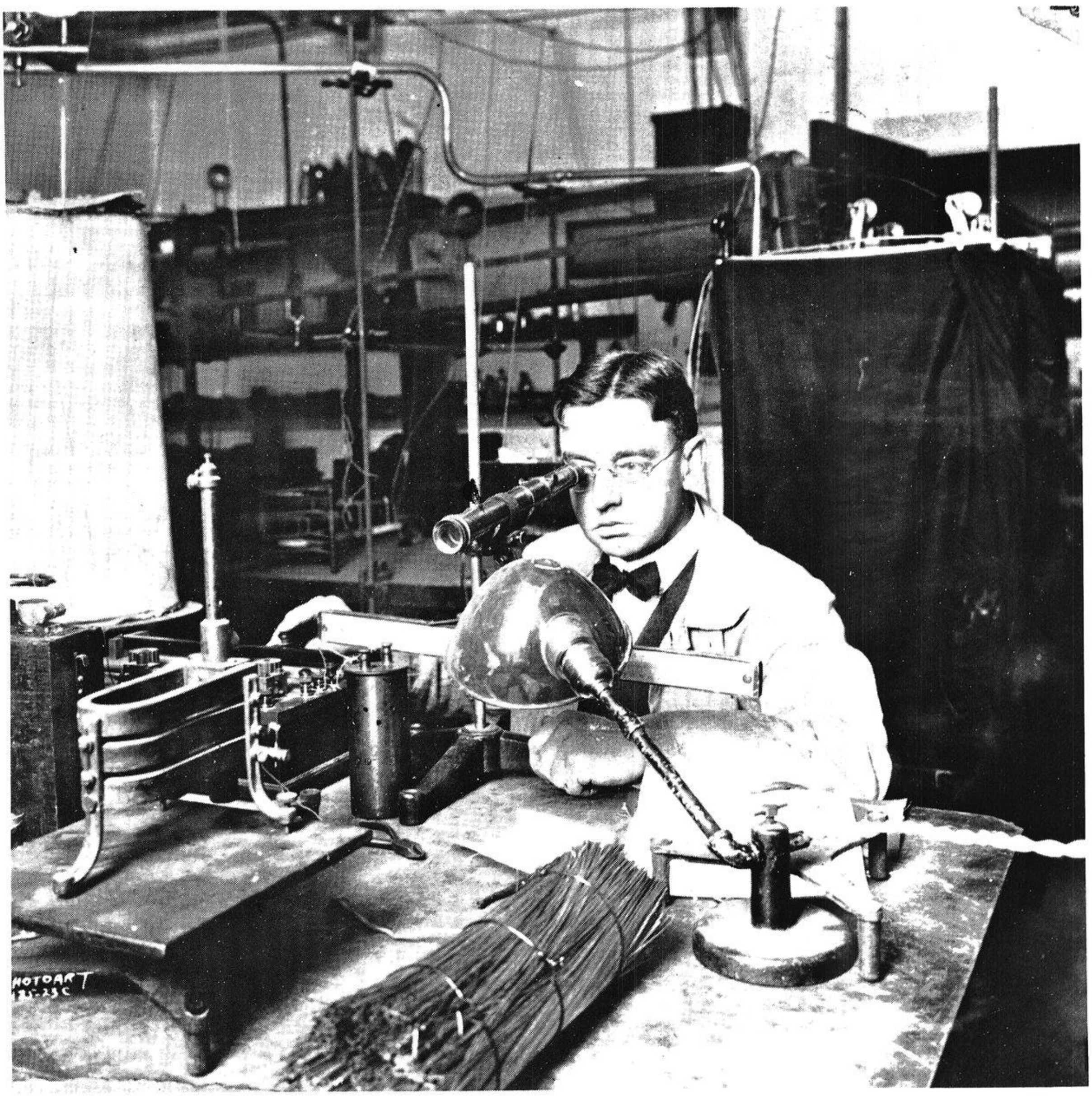
wisconsin engineer



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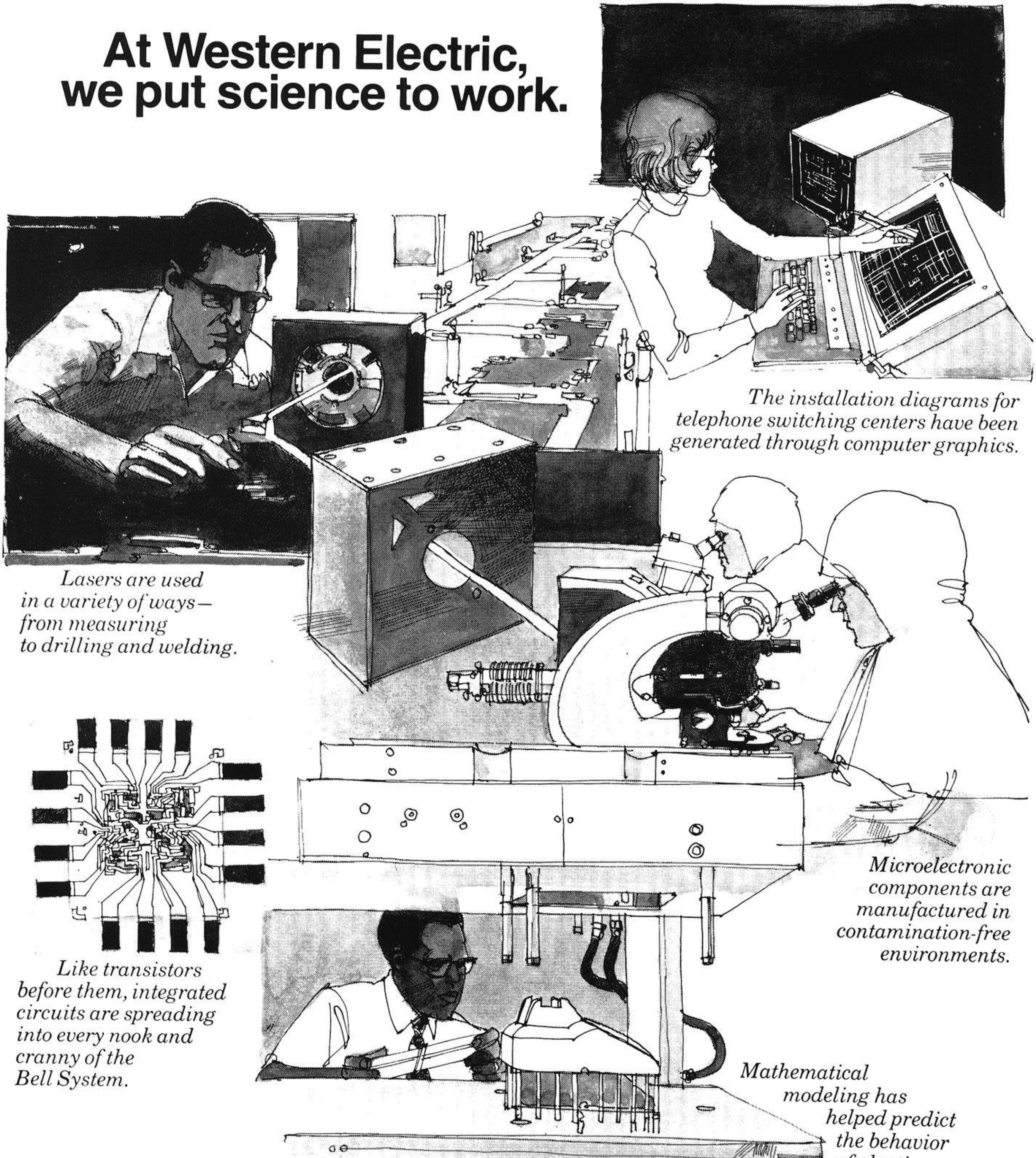

The installation diagrams for telephone switching centers have been generated through computer graphics.

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Microelectronic components are manufactured in contamination-free environments.

Like transistors before them, integrated circuits are spreading into every nook and cranny of the Bell System.

Mathematical modeling has helped predict the behavior of plastics in injection molding.

Managing all this is a new breed of talented people. Whatever their specialties, they also have to be comfortable working in other fundamental disciplines once left only to "pure scientists". At Western Electric, we put science to work.

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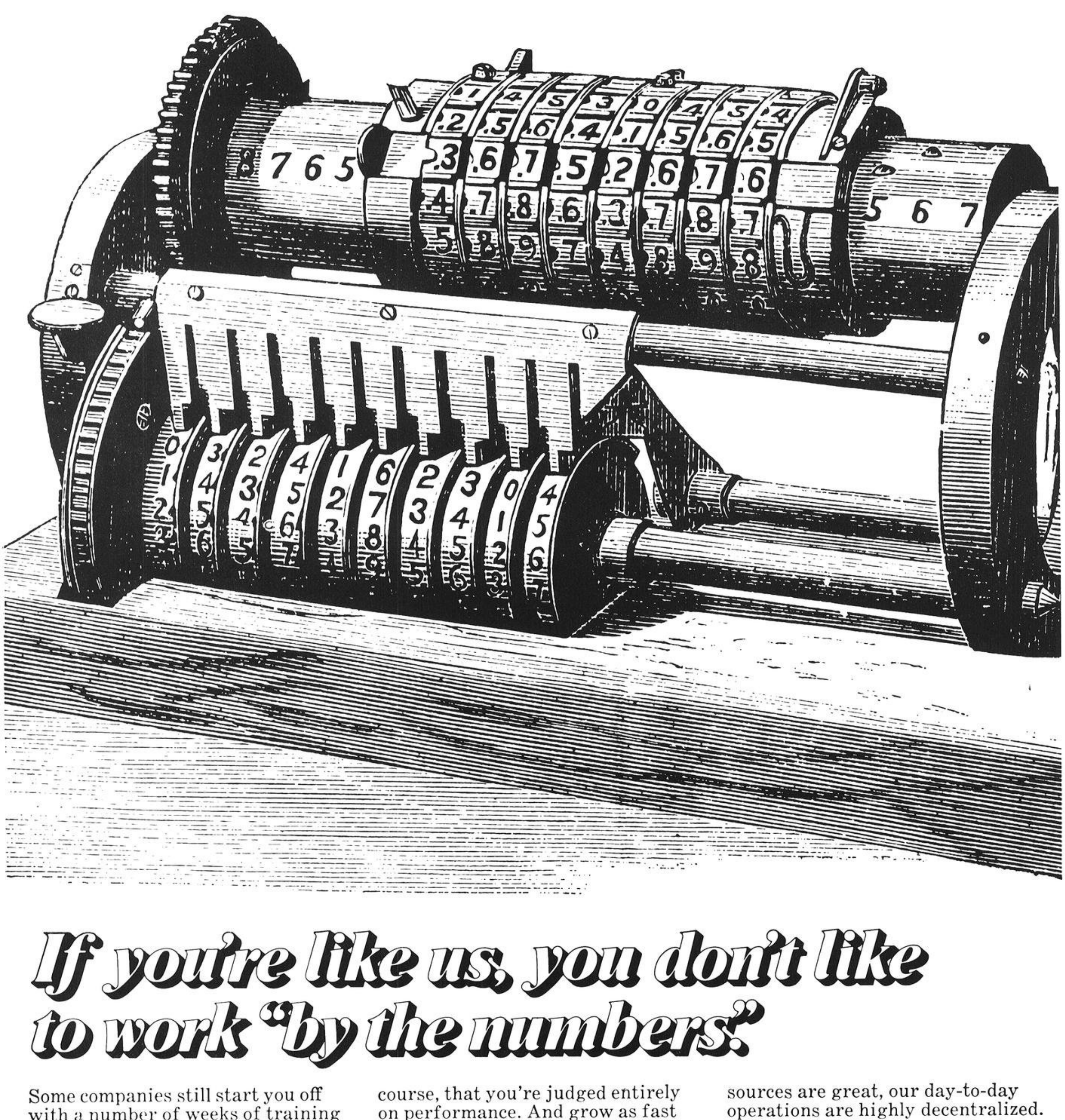

The chessboard is the world, the pieces are the phenomena of the universe, the rules of the game are what we call the laws of nature.

— THOMAS HUXLEY

wisconsin engineer

PUBLISHED BY THE ENGINEERING STUDENTS of the UNIVERSITY OF WISCONSIN

CONTENTS

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EDITORIAL

Research - key to a a new world

Research is the building block upon which most great universities are built. To investigate and advance in all areas of knowledge is considered as important as educating students with already existing information.

This month's "Engineer" theme briefly touches the concept of "Research". Basically our articles deal with research aids such as the Engineering Computer Laboratory, Computerized Literature Searches and a fusion research device called a Proto-Cleo Stellarator. We also introduce the Global Atmosphere Research Program, or GARP, as it is more affectionately known.

Technology seems to have reached the point where original research is conducted only with the help of highly developed, complicated aids, such as a computer, or a receiving antenna. These tools, in turn, are highly researched themselves.

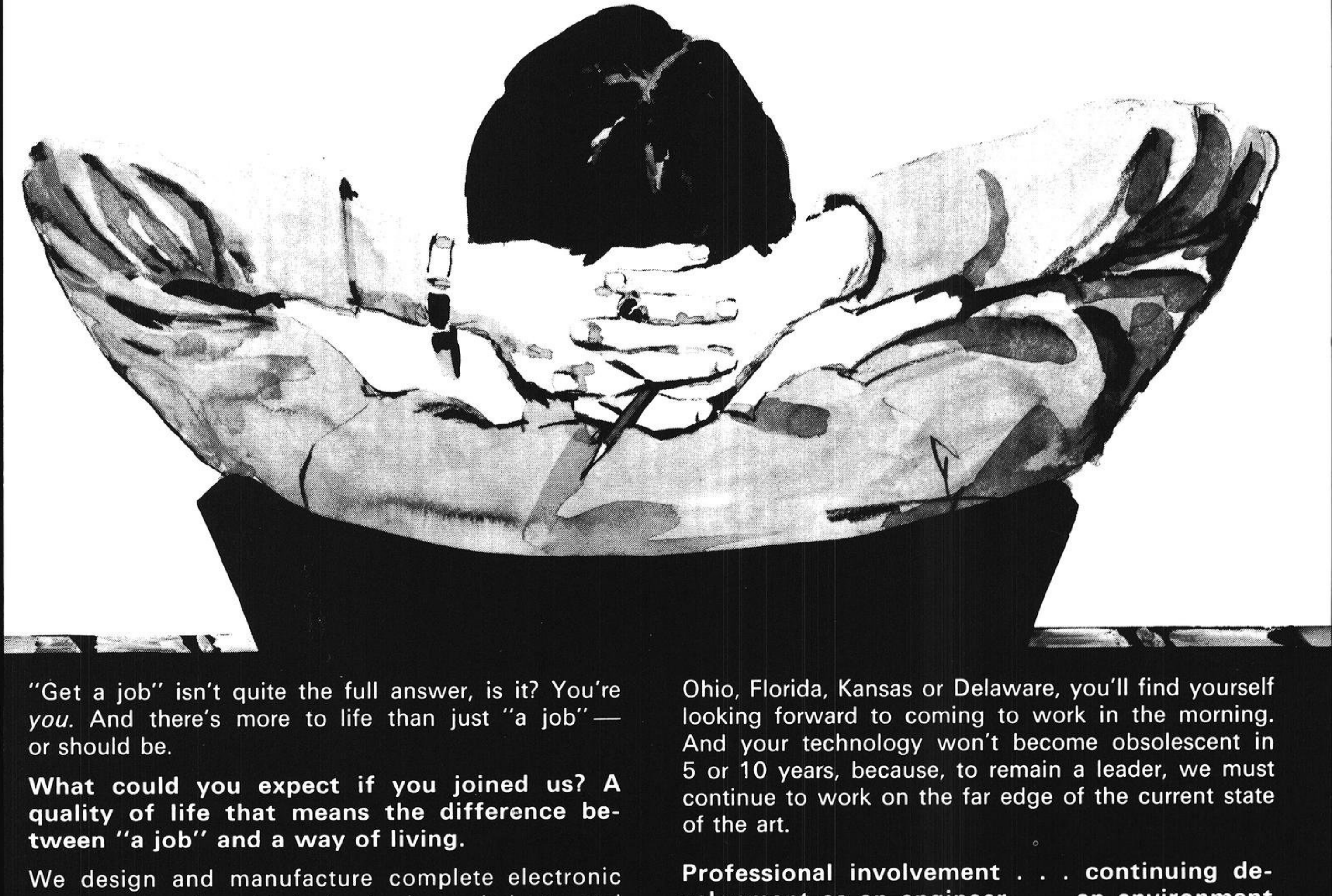
Engineers, in particular, seem bent on finding new ways of doing things or simply improving the old. While most research is usually undertaken by graduate students, undergraduate engineering students are taught the tools of research and they pursue engineering exploration on their own on a smaller scale in their studies.

The UW College of Engineering, through its Engineering Experiment Station undertakes hundreds of research projects each year in civil, chemical, mechanical and electrical engineering.

Examples of projects undertaken during 1972-73 include such topics as: "The Dynamics of Sandwich Construction"; 'Pupillary Light Reflex Studies"; "Organic Phosphorus in Lake Waters" and "Advanced Treatment of Sewage Effluents". These projects get funded from a variety of sources ranging from the National Science Foundation to countless private industries.

Most extensive research involves a pretty hefty topic and it could either flop or provide fascinating results. Often it seems like research is initiated just to maintain funding or keep people in jobs, so it becomes necessary at times to evaluate the fruits of research.

But, all in all, research is vital, especially in the field of engineering if we are ever to evolve to a problem-free technological society for human life. Getting to the sort of utopia via a long, tortuous route lies in some unforeseen future. It lies in the hands of striving scientists and engineers, who have the skill, perserverance and dedication to accomplish the impossible.



Featuring local and national news . . .

SCOPE

KING RESEARCHES ELECTROMAGNETICS

Prof. R.J. King, of the electrical engineering department, is currently involved in the development of a new and intriguing method for the control of electromagnetic waves. Although the project is currently limited to refining the theory involved, the process opens up a variety of interesting applications.

Essentially, the procedure involves the propagation of a traveling wave over the surface of an "active non-uniform antenna". The surface impedance of this antenna can be changed in such a way as to control the direction (and width) of the transmitted beam.

Beam sweeping can be accomplished with no mechanical operations whatsoever. An electronically steerable beam such as this would have an application in aircraft for instance. The antenna would have the form of a continuous sheet of semiconductor material built into the skin of the aircraft itself, resulting in a high degree of beam directivity without disturbing its aerodynamic properties.

COMPUTERS SPEED PIPE DIAGRAMS

Piping designers at Catalytic, Inc. in Philadelphia produce finished isometric engineering drawings in one third the time previously required with the help of a minicomputer, CRT terminal, and time-shared remote computer. Called ISOPER, the system also generates an accurate bill of materials as a byproduct. A tape cassette captures plotting data for making the final drawing on hard copy.

UW TO COORDINATE SCORE

SCORE, the Student Competition on Relevent Engineering, has chosen the University of Wisconsin-Madison as its student coordinating committee for this year's competition. SCORE is a national organization established in 1971 in response to the need for a project-oriented approach to engineering education. The competition is open to all students. This year's theme is "Energy Resource Alternatives." The two previous themes were "Urban Vehicle Design Competition," (1971-1972) and "Students against Fires" (1973-1974).

The competition organization is the responsibility of the student coordinating committee, which distributes rules, answers questions, and keeps all contestants informed on new developments in the competition. The contest ends in August, 1975 when a four day testing and evaluation of all entries takes place.

Persons interested and desiring more information may contact: Dennis Bachelder, Doreen Osowski or Doug Matzke, Executive ERA Coordinating Committee-University of Wisconsin, 1513 University Ave., Madison, Wisconsin 53705.

RESEARCHER MANLEY JOINS STAFF

Students of electrical engineering may be interested to know that Prof. Jack Manley will be teaching here this year. Recently retired, Prof. Manley was a research engineer at Bell Laboratories and co-authored the Manley-Rowe Equations book, interested in helping the beginning engineer, Prof. Manley is teaching ECE 330, Linear Circuit analysis this semester. We wish him a pleasant year in Wisconsin.

WOMAN NAMED ASEE DIRECTOR

Washington, D. C. . .The American Society for Engineering Education announces the election of Dr. Lee Harrisberger as President-Elect; Charles E. Schaffner as Vice President of Finance; Professor Helen L. Plants as a member of the Board of Directors, and Chairwoman of the Council for Teaching and Learning; and Professor Donald N. Zwiep as a member of the Board of Directors, and Chairman of the council for Professional and Technical Education.

ASEE President John C. Calhoun, Jr. in making the announcement noted, "Dr. Plants is the first woman engineer to be elected a director in the 82 year history of the organization. Women comprise only 2% of all engineers, and Dr. Plant's outstanding achievements in the field of higher education reflect her ability and dedication to the engineering profession."

SCHWARZ HONORED BY SAVE

University of Wisconsin-Extension Professor Fred C. Schwarz has been honored by the Society of American Value Engineers (SAVE) as one of the founders of a professional certification program for value engineers.

Presented at the 14th annual national conference of SAVE, the award went to Schwarz and eight other persons who were instrumental in the development and implementation of the SAVE certification program. He also received the society's distinguished service award for education in 1969.

Value engineering — a method of determining the function of a product or service, placing a dollar value on that function and then endeavoring to produce that function at an optimum cost without sacrificing quality — is a relatively new concept but one which has been adopted by thousands of U. S. and foreign businesses and governmental units during the past 14 years.

OCTOPOLE MOVES TO CAMPUS

At this writing, the first 15 tons of the University of Wisconsin's octopole has been moved to its new location in the Astro-Physics Building. The octopole is being moved from the Physical Sciences Laboratory near Stoughton to Madison to make it more convenient to work with. The nuclear and electrical engineering and physics departments use the octopole for advanced plasma research. The octopole is a device for suspending plasma in a magnetic field. Basically it is a large can with a transformer core inside. Loops of aluminum carry current and an octopole - type field is induced confining the plasma within it but, most importantly, isolating it from the container walls.

METRIC MANUAL OUT

As the United States prepares for conversion to the metric system, J. J. Keller & Associates, Inc., announces the publication of the "Metric Manual". This is the first and only such edition in America, and deals with all essential metric data relative to the conversion process.

The deluxe binder edition provides practical background information necessary to understand the full implications of metrication in this country. The "Metric Manual" has required several years of planning and research - and parallels the announcements by several major industries and organizations to convert to the metric system.

The $113,000 a year Joe

Our story involves an ordinary guy. Let's call him Joe. He looks like a lot of other Joes. He could be a teacher, salesman or engineer.

You would think that Joe was a lucky man. For the last 10 years he has had pay increases to match every increase in the cost of living. But Joe is still unhappy. His paycheck does not go as far as it used to.

Economists of the Chamber of Commerce of the United States can explain the chagrin of ordinary U. S. citizen Joe. They tell his story this way.

In 1964 Joe went to work at a pay of $10,000 a year. That year:

- His income tax was $1,200.
- His social security tax was $174.
- His take-home pay was $8,626
- His taxes took 13.7% of his gross earnings.

Now, 10 years later, with a long string of cost-of-living pay increases added to his paycheck, Joe earns $15,400 a year.

- His income tax will be $1,908.
- His Social Security tax will be $737.
- His take-home will be $12,-755.
- His taxes will take 17.3% of his gross earnings.

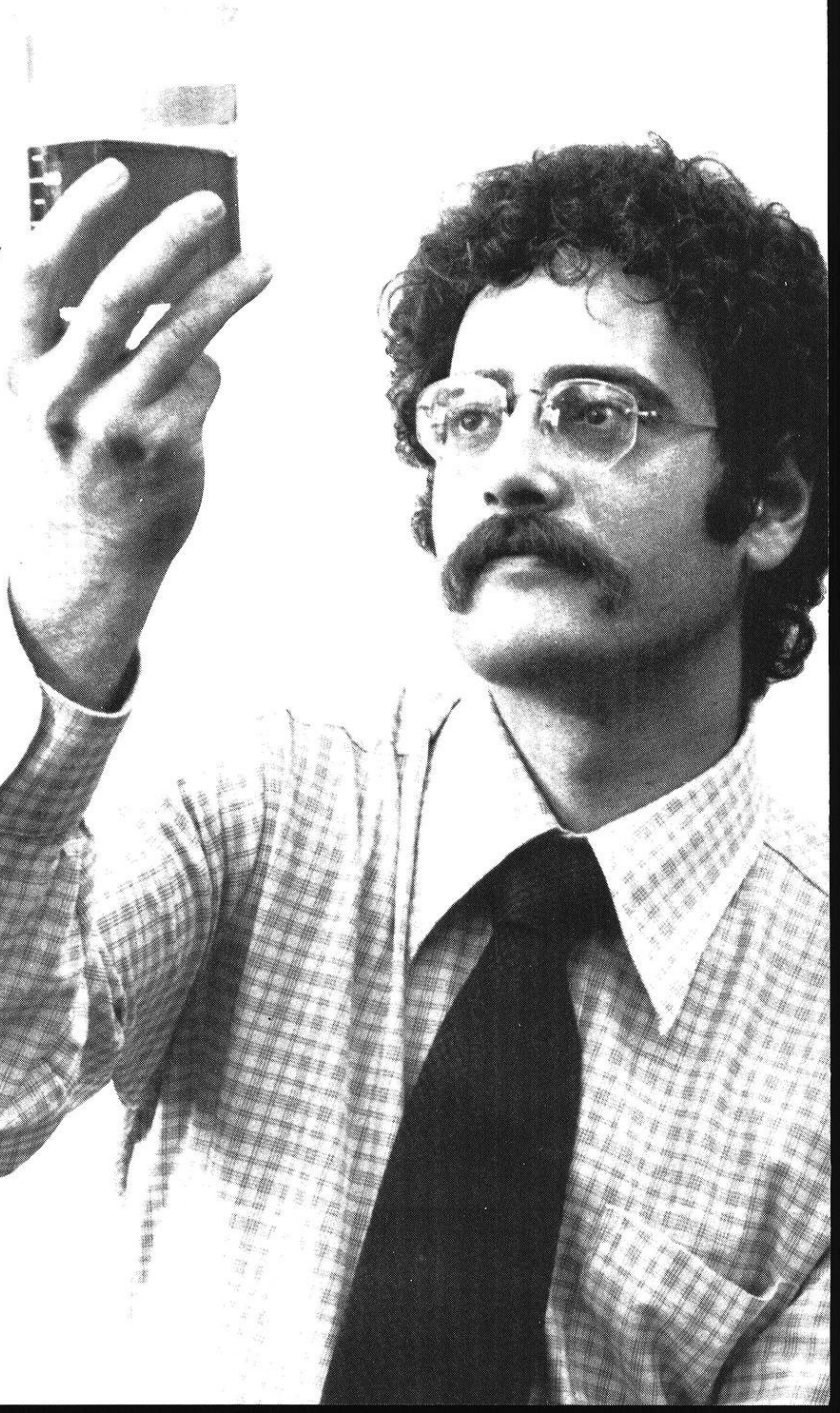
Meanwhile, inflation has eroded the value of the U. S. dollar — by 60% since the end of World War II and by approximately 10% in the last year.

The $12,755 Joe will take home in 1974 really is worth $529 less than the $8,626 he took home 10 years ago.

So take it from Joe. In 20 years, if inflation keeps rising at the 10% rate, Joe will need to earn $113,000 a year to keep pace. Meanwhile, he will be paying out half his earnings in taxes.

And his take home pay of $57,-300 will really be worth only $7,800 of today's dollars.

Sorry, Joe.



wisconsin engineer

Information Please —

Computer Aids Engineering Research

by Karen Slattery
of the Engineer Staff

Anyone who has had to spend time pouring over *Chemical Abstracts* or *Engineering Index* knows how long it can take to begin gathering information on a particular topic. In an effort to aid engineers with this preliminary stage of research, the UW-Engineering Library provides success, via computer terminal, to data bases that contain the above, as well as other, kinds of indexes.

As a result, search time is minimal. For example, it is possible to search *Selected Water Resources Abstracts* in less than one hour. This data file contains 70,000 abstracts and grows at a rate of 14,000 annually.

The search system is a simple one. By feeding key words and combinations of key words from the selected topic area into the data base, via the terminal, it is possible to retrieve the citations and abstracts that will lead to the answers of technical and research questions.

The average search takes between 20 and 30 minutes. The results are in computer printout form and include author, title, source, citations, key words and abstract. Search requestors receive the printout within 5 to 7 days.

The following data bases are located at the Lockheed Palo Alto Research Laboratory in California,* and can be searched through Engineering Library facilities.

CHEMICAL ABSTRACTS - This data base contains 800,000 items, corresponding to issues of *Chemical Abstracts,* covering documents relevant to chemistry and chemical engineering.

ENGINEERING INDEX (COMPENDEX) - This data base contains 200,000 citations and abstracts from 3,500 journals, publications of engineering organizations and selected government reports and books. File growth is at a rate of 84,000 items per year.

For example, it is possible to search *Selected Water Resources Abstracts* in less than one hour.

NTIS - This file contains over 325,000 abstracts of government research from over 240 agencies including NASA, DDC, AEC, HEW, HUD, DOT, Commerce and others. The file grows at a rate of 60,000 per year.

PANDEX - The Macmillan Information Company's Current Index to Scientific and Technical Literature. The file contains 475,000 titles and bibliographic citations from 2,400 journals.

TRANSDEX - 45,000 citations to document translations from the U.S. joint publications service (Macmillan Information Company).

NATIONAL AGRICULTURAL LIBRARY/CAIN - The complete Bibliography of Agriculture file from the National Agricultural Library, including the contents of the NAL catalog as well. The file contains 200,000 citations of agriculture related material. File growth is at a rate of 140,000 citations per year.

INSPECT (SCIENCE ABSTRACTS) - Abstracts from the Institute of Electrical Engineers. INSPEC data bases include:

- Physics Abstracts - 400,000 abstracts from 120 journals covering world-wide literature.
- Electrical and Electronics Abstracts - 200,000 abstracts covering 300 subject areas encompassing electrical and electronic engineering.
- Computers and Control Abstracts - 100,000 abstracts embracing all areas of computers and control engineering.

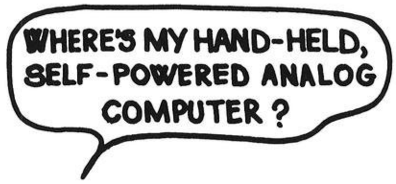
The data bases described below are located at Oak Ridge National Laboratory in Oak Ridge Tennessee and are also accessible through the Engineering Library.

TOXIC MATERIALS DATA BASE - The subject matter includes effects on the environment of numerous toxic substances, including heavy metals such as mercury and lead, cadmium, etc. The data file contains 3,165 abstracts.

MERCURY DATA BASE - Mercury in the environment is the subject matter of the 562 items contained in this file.

HEATED EFFLUENT BIBLIOGRAPHY - This file contains 5,174 items on the subject of the effect of thermal effluents on aquatic life.

ENERGY R & D PROJECTS - The 3,165 items in this file describe the projects and proposed work in energy research by both private and government research institutions.



WATER RESOURCES ABSTRACTS - The 70,000 abstracts include pertinent items of legislation, environmental effects articles, wildlife management, etc. The file is taken from *Selected Water Resources Abstracts.*

COAL GASIFICATION RESEARCH - This file contains 2,554 items and was compiled as part of several new "energy" related files that will be appearing in this data base series in the future.

ENERGY DATA BASE - The subject matter of this data base, which contains 2,306 abstracts, includes use, generation, distribution, environmental effects and sources of all forms of energy.

NUCLEAR SCIENCE ABSTRACTS - The field covered is nuclear research. The data base holds 373,940 citations from the *Journal of Nuclear Science Abstracts* but does not include the abstracts due to the massive size of the file. Citations are added at a rate of 60,000 per year.

POWER REACTOR DOCKETS - This file was begun in late 1973 and is designed to hold most of the power reactor docket citations that were previously found in the Nuclear Science Abstracts Data Base. This file contains 4,894 items.

NUCLEAR SAFETY INFORMATION CENTER - This file contains 80,000 abstracts dealing with regulatory information, news articles, etc.

Other computerized literature searches available through the Library, but not performed there, include NASA Literature Searches (covers *Scientific and Technical Aerospace Reports and International Aerospace Abstracts*), Defense Documentation Center Literature Searches (covers AD Reports) and Air Pollution Technical Information Center Literature searches. These searches are free of charge and requests may be made at the Library's Federal Reports Center.

The costs for searching the data bases at Oak Ridge National Laboratories are $1.00 per connect minute plus first class postage for off campus mailing of the printout. Costs for searching the data bases at Lockheed Palo Alto Research Laboratory are the same but an additional charge of 5 to 10 cents for printing each citation is made.

Interested persons are invited to view computer terminal operations in the Water Resources Information Program Office, Room 392 of the Mechanical Engineering Building, located at 1513 University Avenue in Madison.

* Data file descriptions from DIALOG - Terminal Users Reference Manual Lockheed Palo Alto Research Laboratory

Dean's Page

Research and teaching work together

This month's Dean's Page was contributed by Dean C. A. Coberly, Associate Dean of the College of Engineering and Executive Director of Engineering Experiment Station.

Just one hundred years ago, in May 1874, the first bridge crossing the Mississippi River at St. Louis was opened to traffic. The Eads Bridge, named for its designer and builder, was the first to use structural steel actually requiring the development of a new material. It is said to be the first major steel structure and is still in use today.

River crossings are so commonplace today that it is hard to imagine a time when a bridge designer required research and engineering development of a new material—steel. Technological development has been so rapid that we have come to regard major advances as commonplace events. It seems as if everyone believes that a new technical solution to man's problems can always be found if we just spend enough for research. This issue of the Wisconsin Engineer is about research, and consideration of the place of research in the educational program of our college may be of interest.

The goal of engineering research can be regarded as the seeking of new knowledge related to physical and chemical phenomena, electronic and mechanical systems, engineering materials, processing methods, information systems, and engineering design. In practice, engineering research is so wide in its scope that it might best be described as research done by engineers. But the primary goal of the college is education, and research is sometimes thought to detract from our teaching efforts. It does seem at first glance that research and teaching are on separate tracks in competition for funds and for the attention of the faculty, but this is not the case. Research and teaching are intertwined and work together to provide a complete program of professional education. Research programs are selected and carried out to involve students and professors working together. It is intended that important new knowledge be uncovered, and at the same time it is intended that the student learn how to seek the new knowledge. The student applies the skills learned in course work in the research effort and gains confidence in his ability to independently attack unfamiliar and previously unsolved problems. The professor also learns through interaction with the student in the research process and keeps at the forefront of his area of specialization.

In time, the student graduates and moves on to his professional career, taking with him a store of past experience and newly acquired, up-to-date skills. This constitutes an extremely effective transfer of knowledge or information from the university to society at large.

The professor also participates in an information transfer, but to a different group. The research discoveries of numerous students are combined and evaluated, and the pertinent results are transferred into new seminars and graduate-level courses. With further refinement, this information is eventually brought into the basic undergraduate courses. Thus the research is transferred into the teaching program gradually reviewing and keeping it up to date. A professor doing research with graduate students, teaching graduate courses, and teaching undergraduate courses spans the full range of our educational program. This makes possible the knowledge transfer process required to provide the advances in technology needed to help solve man's problems.

In spite of all that has been discovered, the challenges that we face today are as great as those of any other age. We have a vast store of unsolved problems, much more complex than those previously attempted. We need to learn how to build nuclear fusion reactors, to learn how to control the unlimited nuclear reactions of the sun and contain them in a power plant. The successful solution of this problem requires the development of new materials, new heat transfer information, and knowledge about a host of other engineering problems. We need to learn how to solve our transportation problems and the problems of rebuilding our cities. This not only involves new understanding of engines that don't cause pollution and that use less energy, of ways of reducing noise pollution, but also an understanding of the social and political issues involved. We need to learn how to keep our environment clean and to clean up the wastes left by earlier generations. Research can provide the information, and our educational system will help transfer the information to those who must solve the problems.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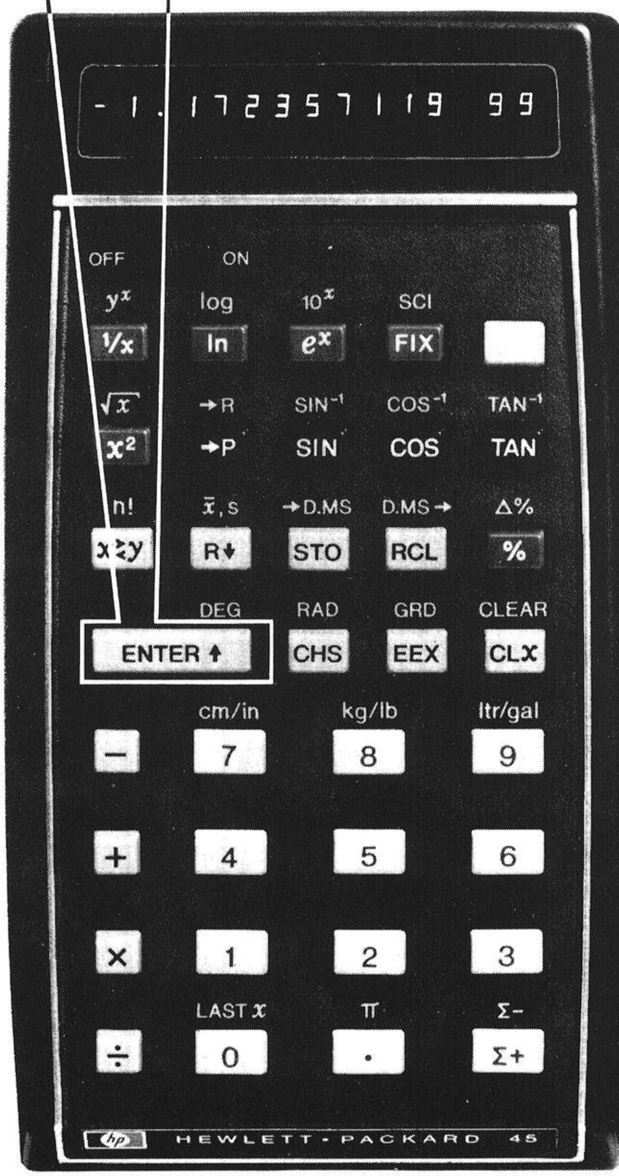
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The HP-45 uses RPN.

That's one reason it's the most powerful pre-programmed pocket-sized scientific calculator. Here are 8 others:

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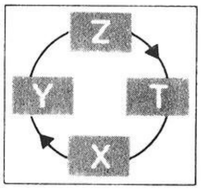
2. 

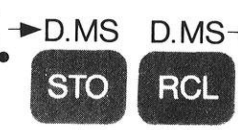
It offers a 4-Register Operational Stack that saves intermediate answers and automatically retrieves them when they are required in the calculation.

3. It lets you store up to nine separate constants in its nine Addressable Memory Registers.

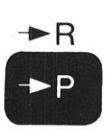
4. It gives you a "Last X" Register for error correction or multiple operations on the same number. If you get stuck midway through a problem, you can use the "Last X" Register to unravel what you've done.

5. 

It displays up to 10 significant digits in either fixed-decimal or scientific notation and automatically positions the decimal point throughout its 200-decade range.

6. 

It converts angles from decimal degrees, radians or grads to degrees/minutes/seconds and back again.

7. 

It converts polar coordinates to rectangular coordinates . . . or vice-versa. In seconds.

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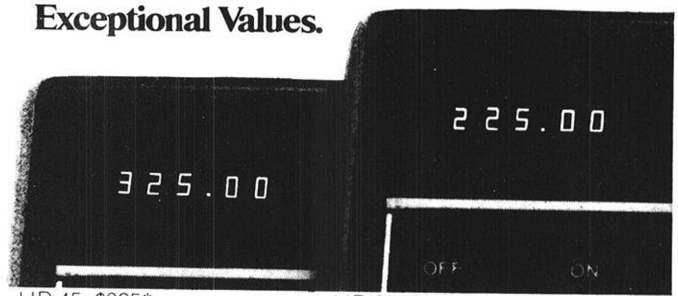
Its Gold "Shift" Key doubles the functions of 24 keys which increases the HP-45's capability without increasing its size.

The HP-35 uses RPN too.

If the HP-45 is the world's most powerful pre-programmed pocket-sized scientific calculator, the HP-35 is runner-up. It handles 22 functions, has a 4-Register Stack, one Addressable Memory Register and also displays up to 10 digits in either fixed-decimal or scientific notation.

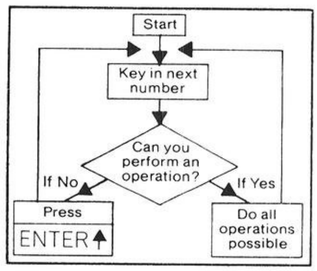
Exceptional Values.



HP-45: $325* HP-35: $225*

The exceptional value of these exceptional machines becomes even more apparent when you consider their prices. You can own the world's most powerful pocket-sized pre-programmed scientific calculator, the HP-45, for just $325.* The HP-35 costs only $225.*

Ask your dealer for our booklet, "ENTER vs. EQUALS."



It demonstrates the superiority of Dr. Lukasiewicz' language by comparing it to other calculators' systems on a problem-by-problem basis, and it explains the algorithm shown to the left which lets you evaluate any expression on a calculator that uses RPN and an Operational Stack. This booklet is must reading for anyone seriously interested in owning a powerful pocket-sized calculator.

Available at leading department stores and college bookstores.

Stop in for a free copy of "Enter vs. Equals," detailed specifications on either the HP-35 or HP-45 and demonstrations of both machines. Call Hewlett-Packard Customer Service, (408) 996-0100 for the dealer nearest you.

Ask about our HP-65 and HP-70 while you're there.

Chances are, he'll also have our two newest pocket calculators on display—the fully programmable HP-65 that lets you write, edit and record programs on magnetic cards and the HP-70 business calculator that can help all business students to excell in their business courses.

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Bring the sun down to earth . . .

Stellarator Studies Fusion Energy

by Mark Holler
of the Engineer Staff

Located in the room above in the Electrical Engineering Building is the Proto-Cleo Stellarator, a research device for studying fusion energy.

Professor Shohet of the Electrical Engineering Department at the University of Wisconsin has acquired a fusion research device called the Proto-Cleo stellarator from the Culham laboratory in England.

Proto-Cleo's main purpose for the moment will be to study basic hydrogen plasmas under various sub-fusion heating conditions rather than the radioactive deuterium-tritium plasmas which will be used to produce fusion energy. The stellarator confines the plasma within a closed toroidal magnetic field surface, sometimes called a "magnetic bottle".

The Proto-Cleo stellarator and all the equipment to operate it along with another similar machine called a Torsatron was purchased last winter. All 36 tons of it was shipped by boat and arrived in Madison on June 21. The tentative date for completing the reassembly is November 15. The price was a modest $25,000 considering estimates that said it would cost a million dollars to build today. It was paid for with funds from the National Science Foundation.

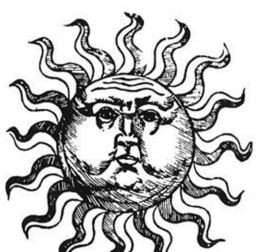
Graduate students working with Professor Shohet include Steve Golovato, John Hamann, Tom Casper, Dave Anderson, Bill Friederich, Rob Uram, Dennis Russell and Tom Geb. Four students accompanied Professor Shohet last winter to England before Proto-Cleo was disassembled and had a chance to familiarize themselves with its operation.

The Proto-Cleo is the only stellarator in the United States today. A larger model called Cleo remains at Culham and stellarators can also be found in Europe and the U.S.S.R., but the UW owns the only stellarator in the United States.

All nuclear power plants in operation today extract energy from some fission reaction involving heavy metal such as plutonium, at. wt. 244, or Uranium, at. wt. 235. The problem with fission reactors is their production of long lasting radioactive wastes and the relative scarcity of fissionable materials.

Fusion reactors will typically use deuterium at. wt. 2, and tritium, at. wt. 3, isotopes of hydrogen. The products of the reaction are a helium nucleus and a neutron of which neither presents a serious waste problem.

The neutron which is uncharged leaves the plasma and enters the cooling jacket and is slowed down releasing its heat to the transfer fluid within the jacket. Neutrons supply the heat from a fission reaction also and in both reactions a number of radioactive contaminants are produced when they strike the wall. The difference is that the reaction products from a fission reaction remain radioactive for much longer, thousands of years compared to the fusion reactor wastes which may decay in just a few years.



The problem of fuel acquisition for a fusion reactor involves no mining because the source is water. Deuterium is readily obtainable from water of any sort polluted or not. Tritium is a little more difficult to come by and must be bred in a nuclear reaction between neutrons and lithium.

One proposed reactor type uses a lithium cooling blanket for heat transfer and in absorbing neutrons from the reaction tritium is produced in the liquid lithium. The tritium is extracted as the lithium flows between the steam generator and the reactor.

The reaction chamber is a toroid with a major radius of 40cm which sits about 5 feet high on a pedestal for easy access to the field coil connections and the various probes which are used for monitoring the plasma inside. Three different sets of helical coils produce the closed toroidal magnetic surface which confine the plasma.

Five thousand 500 UF capacitors supply the current to the coils. When char-ed to 500V the total 2.5 Farad capacitance will supply 15 million Watts of power over a period of 20 milliseconds. The current flowing through the coils will reach a magnitude of nearly 100,000 Amps. The toroidal fields field reaches about 4.3 KGauss.

The hydrogen plasma will be generated by passing an arc between two titanium electrodes once the chamber is evacuated. The plasma is actually much less dense than the atmosphere around us. The density of a plasma might be around $10^{13}/cm^3$ while the air we breathe has a density of $2.6 \times 10^{19}/cm^3$, a million times more dense.

A radio frequency generator will be used to excite the plasma at certain of its resonant frequencies. Transit-time magnetic pumping, which involves modulation of the toroidal field at resonant frequencies, will also be experimented with.

The stellarator is slightly different from the Tokmak, another major type looked on as a better prospect by the AEC. The stellarator uses a helical winding within the chamber to produce the twisted field of the "magnetic bottle" while the Tokamak drives a current in the plasma to produce this field. This plasma current also serves as a first order heating process, but the problem is that this type of heating fails at high temperatures and can only be pulsed requiring the reactor to be shut down and restarted.

The stellarator maintains the field independent of the plasma and if it could be refueled steadily could operate for much longer cycles than the Tokamak.

However, the first concern at this point in the development race is to reach fusion as quickly as possible. In the future, when fusion reactions come fast and easy the stellarator may become the configuration for practical fusion energy, but for the present in this country it will probably stay considerably behind the Tokamak designs which enjoy the financial support of the Atomic Energy Commission.

WE

Introducing . . . ECL

by
Dan Zietlow
of
Engineering Staff

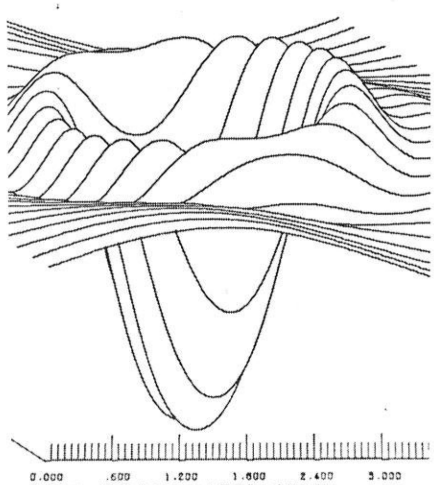
The Engineering Computing Laboratory (ECL) is an open-shop computing facility supported by the College of Engineering students or faculty member for computing work related to instruction, curiosity, or otherwise unsupported research.

The new engineering student learns of the ECL during the freshman lectures program. He gets a brief tour consisting of the use of the computer and applications to it. Usually the student takes a FORTRAN programming course (Comp. Sci. 211) using the Madison Academic Computing Center UNIVAC 1110 found in the Computer Science and Statistics Building before using ECL. He then is required to take a tour of ECL learning the use of the facilities.

The ECL tour is usually taken at the beginning of the 2nd semester of the sophomore year. It can be taken weekdays at 1:00 P.M. and Saturdays at 9:00 A.M. On the tour you need a University of Wisconsin ID. or fee/card to have your name put on the computer. The operation and use of the keypunch, the use and sequence of control cards to run a program, the different types of languages and subprograms available, and general use of ECL is discussed.

The staff of ECL is headed by Professor Charles Davidson who is assisted by Verlyn Erickson as full time director, and full time secretary is Pat Rosanski. The ECL also employs approximately thirteen graduate and undergraduate students on a part-time basis (10-20 hours per week). Part time students serve as consultants to ECL users and assist and train user to operate the computer.

The computer ECL computer is a Datacraft 6024/3 with 48K memory and scientific Arithmetic Unit (which provides floating point capability). Peripherals consist of a Mohawk Data Sciences Corporation (MDS) line printer, 1000 lines per minute; MDS card reader, 1000 cards per minute; IBM 1620 carder reader/punch, 250 and 125 cards per minute respectively; Datacraft 6006-3 disk unit 28 million bit storage; ASR-33 teletype for control of the Datacraft computer; and a Complot DP-1-1 digital plotter.



MATHEMATICAL WATER DROP

The computer is also available as a remote to the UNIVAC 1110. Also contained in ECL are fifteen keypunches, an interpreter keypunch, DEP cathode ray tube terminal, and desk calculators.

When the Datacraft computer was first received (1971) it was only capable of reading in, working on, and printing out one program at a time. In May of 1972 the Spooled Operating System (SOS) was implemented to achieve quicker turnaround times.

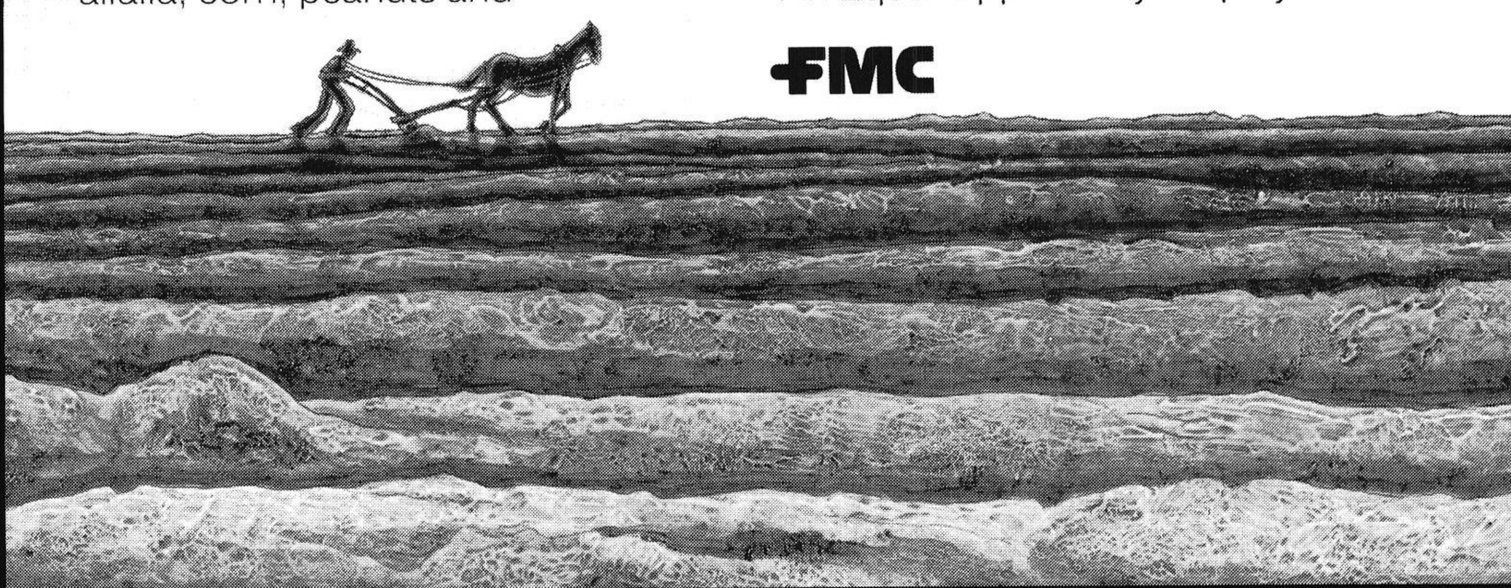
SOS, written by the ECL staff, directs jobs from the card reader to one of the several storage locations on the disk, depending upon their length. Similarly, jobs (a program run) are "spooled" onto the disc after returning from the computer. This gives the smaller jobs higher priority both in memory and on the printer.

With this system only one input/output terminal can be used at one time. Since several terminals are becoming available, primarily at CRT terminal, ECL is working on a new syte (DMS-3) to allow interactive use of several terminals.

The primary language used on the datacraft is FORTRAN IV which has been augmented. Also there is FORGO a diagnostic FORTRA similar to UNIVAC'S DRITAN but more comprehensive. Generally the augmented FORTRAN runs 20-500% faster than UNIVAC FORTRAN and FORGO 3-10 times faster. The ECL personal has obtained numerous "canned" application subprograms such as ECAP, an adaption of the Electronic Circuit Analysis Program, for user convenience.

The ECL is open Monday — Thursday 8:00 A.M. to 9:00 P.M., Friday, 8:00 A.M. to 5:00 P.M., and Saturday, 9:00 A.M. to noon. The Datacraft is not available until 9:00 A.M. on weekdays. Users will find that the turnaround time is faster than While-You-Wait at the UNIVAC 1110 terminal in the basement.

The ECL has been striving to provide the user with better facilities and service to improve the quality of engineering education at the University of Wisconsin and will be as long as there is a need for the computer in society. WE



"GARP" Antenna Researches Weather

by Jeff Kratz
of the Engineer Staff

To most of us, GARP is something you say when you swallow a fish bone. But to the 140 people who work at the Space Science and Engineering Center on the Madison campus, GARP represents a vital, current meteorological research experiment.

The Space Science and Engineering Center (SSEC) is located in the Meteorology and Space Science Building in West Dayton Street. They are the people who use the giant receiving antenna on top of that building to collect weather satellite pictures, especially when running experiments like GARP.

GARP stands for the Global Atmospheric Research Program. This program is really a series of different experiments designed to learn more about phenomena in different parts of the world.

The GARP research happening today comes under the name of GATE, which stands for the Global Atlantic Tropical Experiment. Over 66 countries, 22 ships, 14 planes and 1800 scientists are taking part. The experiment is headquarted in Dakar, but most of the raw data that is collected is provided by the SSEC.

The giant receiving antenna on top of the Meteorology building receives signals from an extremely high-orbiting weather satellite. This satellite is located about 22,000 miles straight up from Dakar, and it is stationary. Its orbit speed is the same as the speed of the earth's rotaton.

The Satellite, designed by Verner Suomi, Director of the SSEC, consists of a camera fitted onto a telescope, along with sending and receiving apparatus. The whole satellite rotates at 100 rpms, with the camera-telescope being aimed by a mirror attached to the end. After each revolution, the mirror changes its angle a tiny bit, thus allowing each rotation or "sweep" of the camera-telescope to scan a different part of the earth below. This provides for the familiar "horizontal" effect that appears on most weather satellite photographs.

Each sweep of the satellite used for GATE covers a distance of only one half mile on the earth. According to Thomas O. Haig, Executive Director of the SSEC, this tiny sweep width allows for pictures of extreme clarity.

"We get one picture every 18 minutes from the satellite," says Haig, "but that picture will represent nearly a hemisphere and consist of 14,400 lines, or individual sweeps. When you consider that the average television set has only about 500 horizontal lines, you can appreciate how detailed these pictures are."

Haig explains that the pictures are transmitted from the satellite by use of a digital timed signal. Like a binary computer, a digital signal is either "on" or "off". These signals are sent in groups of six as the sweep progresses, meaning that there are 64 possible combinations of timed signals. Each of the combinations refers to a different shade of light, thus allowing the final composite picture to reflect exact amounts of cloud cover, its thickness, and other detailed weather patterns.

Once the Center has received these timed signals through its antenna, they are fed into a specially designed video slant track recorder which has been modified to record digital data. Haig says this device is another invention of the Center, and was developed with the help of the Madison engineering campus.

After the signal has been recorded, Haig explains that it is fed into another recorder, then into a computer, and finally to an enhancer and video screen.

At this stage it is possible to see the composite picture with a great deal of clarity only minutes after it has been sent by the satellite. The computer that displays the picture on the video screen is another invention of the center, and allows for the tracking of individual weather phenomena, even individual clouds only one half mile wide.

Haig notes that the computer also has been designed to track across different altitudes, thus allowing those viewing the pictures on the computer's video screen to see how clouds in the same place but at different altitudes are moving, and to determine if individual clouds are rising or falling as they move.

This gives a clearer picture of the wind patterns in the area, according to Haig, and this in turn permits a closer analysis of what is really happening weather-wise in the area being studied.

The GATE research being done is especially concerned with wind patterns and strengths. Haig notes that this information is now available from a weather satellite and there is no longer a need to use costly weather flights and balloons to measure the same phenomena.

Information collected by the Center is then passed on to the researches in Dakar for use in their on-the-spot experiments. Many of the people there are connected with the University of Wisconsin, including some engineering students who spent their summer there doing research work.

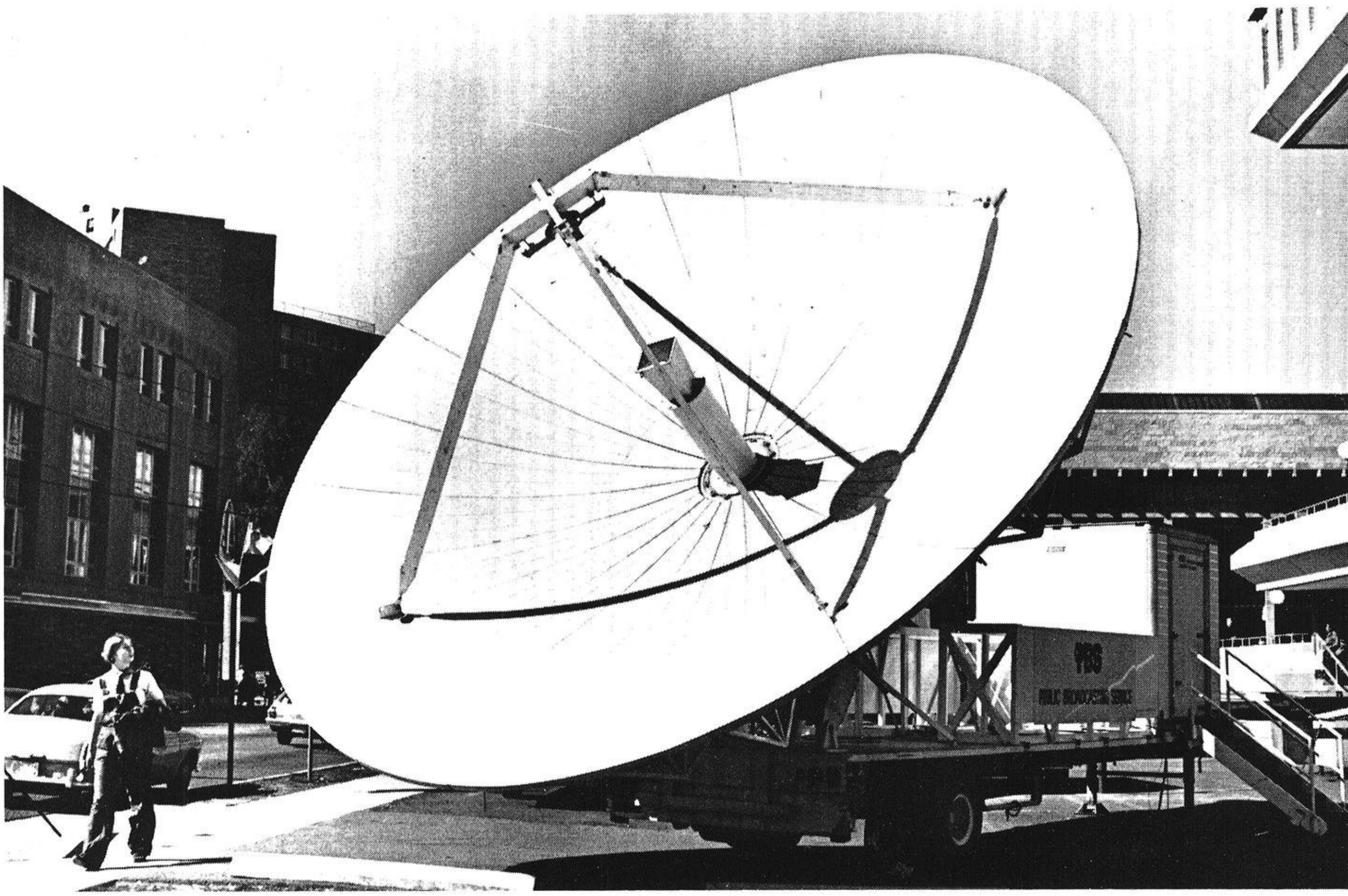
National Oceanic and Atmospheric Administration (NOAA). The Center is connected to the University through the Graduate School, but operates as an independent research center.

GATE is not the only research project currently underway at the SSEC. "We are trying to develop a system of Nowcasting," explains Haig. "This means we are trying to coordinate our satellite pictures into a computer system that will allow us to report on weather phenomena as they happen. For example, we would then be able to look at a thunderstorm as it approached Madison and predict

not reflect the true situation at the time they are broadcast on the television. The Center wants to devise a way to get their pictures to the television stations while they are still showing the current weather picture.

All this will require more time, more theoretical perfection and more hardware. Haig explains that the Center's staff is mixed between meteorologists and engineers with this in mind.

"We try to employ as many engineering students as we can," says Haig. "They get a chance here to work on real projects. It is not a classroom exercise."



Haig says the center employes anywhere from 40 to 60 students, both graduates and undergraduates. Many of these are engineering students. Since the Center produces both hardware and reports, it is possible for students to gain practical experience in design.

The SSEC has a budget of close to $2 million annually. Nearly all of this comes from federal organizations like the National Aeronautics and Space Administration (NASA) and the

that it would be over such an area in 10 minutes, move on to this area in 20 minutes and disappear altogether over this area at this time. People would be able to know what is going to happen in the next hour, not what we think will happen over the next day."

The Center is also trying to develop a system to produce video loops for use on commercial television stations. Haig notes that most stations that use satellite pictures now are using pictures that are already many hours old, and may

If the future plans of the center are going to become reality, it will require more and better weather satellites. It is in this area especially that many of the engineering students work.

"We will need many more satellites for a system like Nowcasting to become a practical reality," says Haig. "We will also have a devise system to get more out of the information they can send us."

Research is an ongoing business at the SSEC. WE

Co-op education gathers speed

by Randy Bates

The cooperative education program at the College of Engineering of the University of Wisconsin has started to pick up momentum in the last year or so. More and more engineering students are realizing that practical experience in their field is an essential part of their college career. One of the more realistic ways to get this programmed work experience is through the co-op program.

A student under this program will alternate semesters of work with semesters of attending school. This schedule usually results in the student requiring an additional year before completing his degree requirements.

The benefits of this program, however, are many. The student is able to apply the theory learned in textbooks to solving the highly technological problems experienced in industry. As the student's knowledge of his field increases, so is the challenge and responsibility placed on him increased by the participating company.

The programs usually include a wide range of experiences, providing the student a broad taste of engineering as it applies to industry. For people such as myself who are working their way through college, my work sessions are providing me not only with the valuable experience, but also with the money to continue in engineering.

Probably one of the greatest advantages of the co-op program is that it gives the student a chance to decide whether his field is right for him, BEFORE it's too late to change.

I am presently coping with the U.S. Geological Survey here in Madison as a civil engineer and find the atmosphere extremely challenging. I have been more or less assigned to a specific project under the direction of another civil engineer who graduated from the University of Wisconsin. In this project, I have done a lot of the basic field work necessary to collect the data, as well as a lot of the computations and the drafting required to assess and tabulate the information.

This work experience will continue to be a high point of my professional career. Professor George Sell, director of the cooperative education program, has done an excellent job in setting up the guidelines of this program for both the students and the participating companies.

If any students are interested in this program, they may either contact Professor Sell of the Mechanical Engineering Department or any of the co-op students for more information. This is truly one program in which the student has the most to gain professionally.

WE

Food For The Future

by Jeanne Fisher of the Engineer Staff

When someone mentions "protein" you think of a nice, juicy steak, right? Think again.

The worldwide food shortage has made it necessary to look for new sources of protein. Ed Payne, a University of Wisconsin PhD. candidate in Chemical Engineering, has his eye on alfalfa leaves.

Alfalfa juice contains about the same relative amounts of the eight essential amino acids of protein as milk. Protein, "the building block of life," is a daily necessity in the human diet. Alfalfa proteins are better for the body than beef, casein (the basis of cheese), soybeans, yeast, and wheat flour.

Although cows can readily digest alfalfa leaves, humans cannot. And alfalfa juice doesn't taste very good. These problems must be overcome before humans accept alfalfa as a viable alternative to animal proteins.

Payne plans to circumvent these difficulties by extracting the protein from the non-digestible part of the leaves and making a bland concentrate. If he's successful, this highly nutritious concentrate could be added to breakfast cereals, baby foods, soup stocks and pet foods without interfering with their flavor.

Payne's method for protein extraction calls for using enzymes, powerful catalysts, to aid the desired reaction. The catalytic qualities of various enzymes can speed up reactions 10 to 20 million times. Since enzymes are a type of protein themselves, they are more efficient and selective than other kinds of catalysts.

Just how enzymes work is not completely understood yet. But it is known that enzymes have "active sites" which match up with a specific part of the molecule being acted upon, something like a key with a lock. The activity of enzymes is highly dependent on temperature and pH, the measure of acidity and alkalinity. Wine fermentation and cheese production are examples of natural processes controlled by enzymes.

In the case of alfalfa, Payne will use enzymes to split the protein contained in the leaves into smaller pieces, called peptides. These peptides should be small enough to pass through a layered membrane which will act as a strainer. The undigestible part of the leaves will be larger than the holes in the membrane and will not be able to pass through.

In effect, the green chlorophyll and the "saponins," which cause a bitter taste in alfalfa, will be stopped by the membrane. This separation technique is called ultrafiltration. A definite advantage to this process is that the enzyme can be continuously reused.

Payne hopes that the resulting proteins or peptides will be bland in color and taste in order to mix undetected with other foods. While he is not alone in working with alfalfa leaves, his method is different. The Food Science and Biochemistry Departments are using alfalfa as a growing medium for yeast, and then using the yeast protein. Another method is to concentrate the alfalfa juice and use it "as is" although its taste is bitter. "My method may be more expensive," says Payne, "but I expect to have a better quality product."

Payne thinks that a vegetable protein, such as the one he is trying to extract, might be more readily accepted by the public than the fish protein concentrate (PFC) already on the market. Sales of FPC have been less than overwhelming, perhaps because people mistakenly expect it to have a "fishy" taste. At present, the four largest selling protein concentrates are non-fat dry milk, dry whole milk, soy protein, and casein.

Enzyme research projects are springing up in many different areas. Ideas can come from anywhere. In Ed Payne's case, the impetus came from the Food Science Department. "I got the idea of how to solve the world's food problems one day while sitting in the middle of an alfalfa field with a bottle of wine and a ukulele," he says. "But actually alfalfa because the Food Science Department had a big project going with alfalfa uses. The idea was there and the possibilities looked good."

Other Enzyme researchers have already found ways of making sugar and starch from trees, petroleum, computer paper, and wallboard. This may not be your idea of a feast, but the concept of making food from anything not ordinarily digestible or nutritious is important. The population explosion will make it increasingly difficult to feed the hungry, especially in developing nations.

Here in the United States as well, many people are unknowingly suffering from malnutrition. The endless consumption of snack foods with "empty calories" expands the already growing numbers of overfed but undernourished people. Protein supplements can and do help round out the nutritive value of many foods.

Although any new protein concentrate would be a boon, alfalfa protein may have a little something extra. After all, did you ever hear of a discontented cow?

October Interviews

THURSDAY, OCTOBER 10
Aerojet Nuclear (1 of 2)
Arthur Andersen (2 of 2)
Corning Glass (1 of 2)
Factory Mutual
Globe Union
Harvard School of Bus. Admin.
Penn Controls
Procter & Gamble - 4 divisions
Stauffer Chemicals-PhD's (1 of 2)
Trane Co. (3 of 4)

FRIDAY, OCTOBER 11
Aerojet Nuclear (2 of 2)
Corning Glass (2 of 2)
General Motors (All divisions)
Oscar Mayer
Modine Mfg.
Pfizer Co.

MONDAY, OCTOBER 14
Amoco Chemicals (Std. Oil of Ind.)
Amoco Oil
Fisher Controls
B. F. Goodrich
B. F. Goodrich (PhD's) (1 of 2)
Ohio Brass
Scott Paper
Std. Oil of California (1 of 3)
Uarco (1 of 2)
Unico
N.S.A. (1 of 2)

TUESDAY, OCTOBER 15
American Electric Power
Bell System (1 of 4)
Continental Oil (1 of 2)
Consolidation Coal (1 of 2)
Dow Chemical (1 of 2)
Std. Oil of California (2 of 3) if
Union Carbide Corp. (5 divs.) (1 of 2)

WEDNESDAY, OCTOBER 16
Bell System (2 of 4)
Continental Oil Co. (2 of 2)
Consolidation Coal Co. (2 of 2) if needed
Dow Chemical (2 of 2)
General Dynamics
Shure Bros.
Std. Oil of California (3 of 3)
Union Carbide Corp. (2 of 2)
U. S. General Accounting
U. S. DOT - Federal Highway

More Interview Opportunities

THURSDAY, OCTOBER 17
Ansul (1 of 2)
Cargill
Chicago Bridge & Iron
Cleveland Cliffs Iron
Falk Corp.
General Dynamics - Electric Boat Div.
Honeywell (1 of 2)
Indiana Dept. of Natural Resources
National Steel
Northern States Power
Stanford University-Graduate School
Underwriters Labs (1 of 2)

FRIDAY, OCTOBER 18
Ansul (2 of 2)
Babcock & Wilcox
Barber Colman
Beloit
Commonwealth Associates
Commonwealth Edison
Globe Engineering
Honeywell (2 of 2)
Illinois Dept. Transportation-Waterways
Underwriters Labs (2 of 2)

MONDAY, OCTOBER 21
C. F. Industries
Combustion Engineering
DeSoto Chemicals
DuPont (1 of 5)
Eastman - PhD's (1 of 3)
Gibbs and Hill Inc.
Intel
Square D Co. (1 of 2)
Naval Nuclear Power Directorate
Naval Civil Engr. Labs (Cal.)

TUESDAY, OCTOBER 22
American Cyanamid (1 of 2)
DuPont (2 of 5)
Exxon (1 of 3)
FMC Corp. -Northern Ordnance
Florida Power and Light
Foseco
Illinois Tool Works (1 of 2)
Rexnord
Square D (2 of 2)

WEDNESDAY, OCTOBER 23
Allen Bradley
GTE Automatic Electric
DuPont (3 of 5)
Exxon (2 of 3)
Goodyear Tire & Rubber (1 of 2)
Mirro Aluminum
Mobil Oil (1 of 2)
Nekoosa Edwards
Oilgear
Union Carbide Corp. (PhD's)

THURSDAY, OCTOBER 24
Arabian American Oil (Eve. Mtg.) (1 of 2)
DuPont (4 of 5)
Ethyl (1 of 2)
Exxon (3 of 3)
Ford (1 of 2)
Goodyear Tire (2 of 2)
Peoples Gas
Pratt & Whitney (1 of 2)
Texaco (1 of 2)

FRIDAY, OCTOBER 25
Allied Chemical
Arabian American Oil (2 of 2)
Baxter Labs
SuPont (5 of 5)
Eastman
Ethyl (2 of 2)
Ford (2 of 2)
Mead Johnson (4 of 4)
Pratt & Whitney (2 of 2)
Texaco (2 of 2)
BASF Wyandotte Chemicals

MONDAY, OCTOBER 28
Caterpillar (1 of 3)
Conwed
Eaton Corp.
Hamilton Standard (1 of 2)
Johnson Service
3M Co. (1 of 4)
Newport News Shipbuilding
Olin Corp.
Raytheon (1 of 2)
Shell Co. (1 of 3)
Upjohn
U. S. Patent (1 of 2)

TUESDAY, OCTOBER 29
Armstrong Cork
Caterpillar (2 of 3)
Charmin Paper (1 of 2)
Hamilton Standard (2 of 2)
I.B.M. Corp.
Interstate Power
3M Co. (2 of 4)
Raytheon (2 of 2)
Shell Companies (2 of 3)
U. S. Patent (2 of 2)

WEDNESDAY, OCTOBER 30
Burroughs
Calspan Corp.
Charmin Paper (2 of 2)
Clark Dietz & Associates (1 of 2)
Engelhard Industries
Lawrence Livermore
3M Co. (3 of 4)
Mitre Corp.
N. L. Industries (1 of 2)
Shell Companies (3 of 3)
Youngstown Sheet & Tube
N.O.A.A. (2 of 2)

THURSDAY, OCTOBER 31
Clark Dietz & Associates (2 of 2)
Continental Can
General Foods (1 of 2)
Heil Co. (2 of 2)
International Harvester
Eli Lilly
N. L. Industries (2 of 2)
St. Regis Paper
Sperry Univac (2 of 2) Data Processing
U. S. Steel
Wisconsin State Government
U. S. Naval Ordnance

FRIDAY, NOVEMBER 1
Air Products
Bethlehem Steel
Chemplex
Container Corp. of America (2 of 2)
General Foods (2 of 2)
General Mills
Johnson's Wax
Ladish
Republic Steel (2 of 2)
Wisconsin Power & Light (1 of 2)

MONDAY, NOVEMBER 4
American Appraisal (1 of 2)
Amoco Prod. Research Center
Boeing (1 of 2)
Masonite
Ren Plastics

TUESDAY, NOVEMBER 5
Boeing (2 of 2)
I.T.T.
Oak Industries

WEDNESDAY, NOVEMBER 6
Gulf Research & Development
Corps of Engineers
N.A.S.A. -Lewis Research Center (1 of 2)

THURSDAY, NOVEMBER 7
Chicago Northwestern R.R.
Hammond Organ
Bureau of Reclamation
N.A.S.A. -Lewis Research Center (2 of 2)

FRIDAY, NOVEMBER 8
Bucyrus Erie
Firestone
Rockwell International

MONDAY, NOVEMBER 11
U.S.A.F. (1 of 2)
U. S. Marines (1 of 2)

TUESDAY, NOVEMBER 12
U.S.A.F. (2 of 2)
U. S. Marines (2 of 2)

MONDAY, NOVEMBER 18
U. S. Navy (1 of 2)