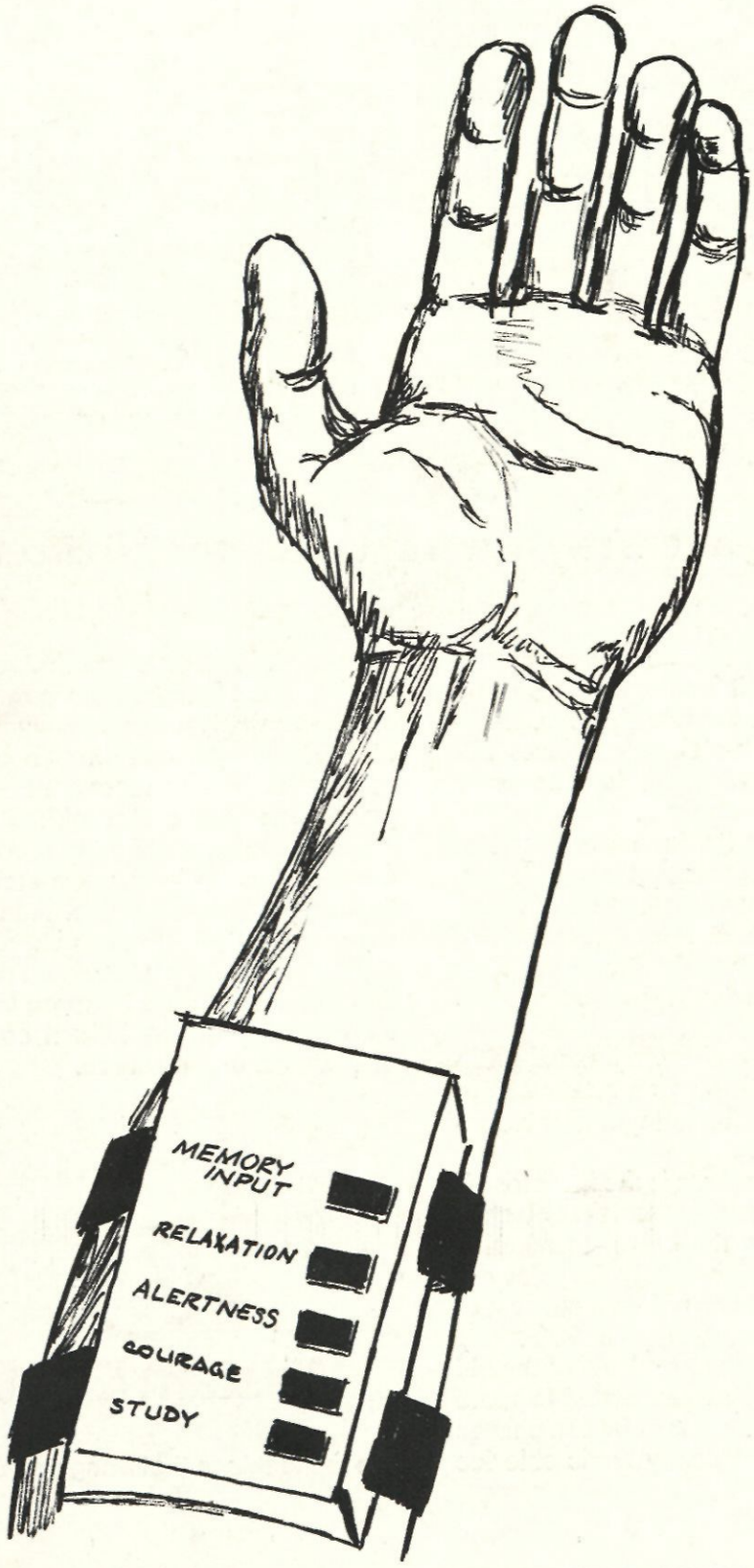
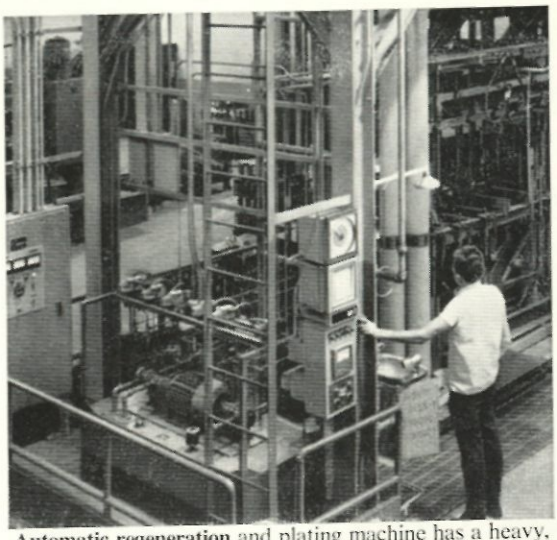
The COLORADO Engineer

OCTOBER/ NOVEMBER 1972

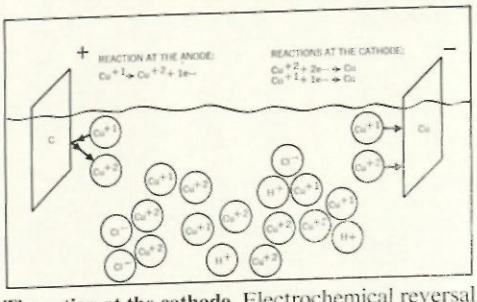


MEMBER ENGINEERING COLLEGE MAGAZINES ASSOCIATED

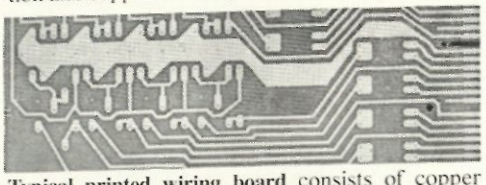
WESTERN ELECTRIC REPORTS



Automatic regeneration and plating machine has a heavy, rubber-lined tank with 22 stationary graphite anodes and 57 rod-like copper cathodes moving at the rate of 90 transfers an hour.



The action at the cathode. Electrochemical reversal of the etching reaction effecting etchant regeneration and copper recovery.



Typical printed wiring board consists of copper (only 0.0028 inch thick) laminated to a phenolic-resin panel. With the new process, unwanted metal is etched away with cupric chloride.

Creating an entirely new way to etch printed circuits.

One of the most common methods of printed circuit manufacturing is by batch-etching with ferric chloride. However, while batch-etching produces circuits of high quality, it also has some processing disadvantages.

For instance, it takes more and more etching time as the etchant is used. Then, to replace the spent etchant means considerable downtime. And the etching of 100,000 circuit boards produces 2000 pounds of copper in a non-recoverable form.

Engineers at our Columbus, Ohio plant set out to discover a better way to etch that would eliminate all of these inherent problems.

Their new process is the first closed-loop, spray-etching system that electrolytically reverses the chemical reaction of etching. It continuously recycles cupric chloride and has reduced the cost of etching wiring boards by over 90%.

Virtually all the problems of the old method have been overcome. No more machine downtime is required to change etchant. No more costly ferric chloride is needed. Etchant strength does not diminish. The etching rate is now constant and faster than the average ferric chloride rate. There's no more waste of etched copper. It is now recovered, about 20 pounds per hour, and resold.

Conclusion: The first completely closed-loop cupric chloride etching system in the printed circuit industry is a major innovation that has improved efficiency and quality, eliminated downtime and decreased costs by more than 90%. Furthermore, it has helped conserve a valuable natural resource.

Western Electric

We make things that bring people closer.

notes & news

Help Wanted—Steelmaking

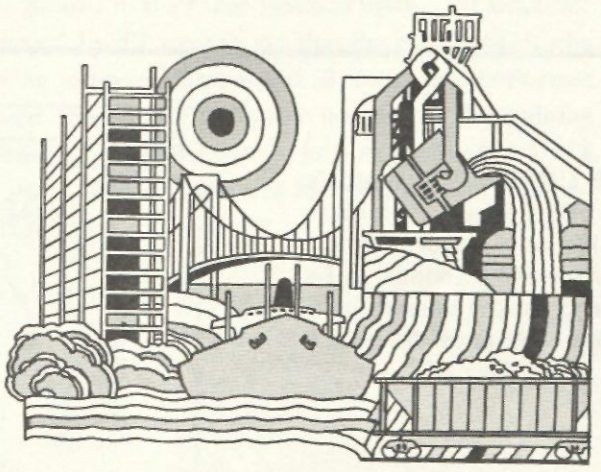
We're planning to talk with a lot of candidates for employment in Steel Plant Operations during the next few months. Students working toward M.E., Met. E., E.E., or several other engineering or technical degrees should give serious thought to careers in steelmaking through the Bethlehem Steel Loop Course. And remember, we're a leader in steelmaking technology—our capital investments total $980 million for the last three years alone!

A word to the wise—COAL

According to the U.S. Bureau of Mines, our nation's consumption of bituminous coal will *double* by the year 2000. That fact alone suggests something about career opportunities in the coal operations of our Mining Department. We're looking for mining, electrical, and mechanical engineers.

Steel's magnetic "personality"

Iron and steel are magnetic. So, what's the big deal? Just this: ferrous wastes are the easiest materials to recycle. Magnetic extraction separates ferrous scrap from trash, recovers metal after waste incineration, even permits "mining" of dumps. About 50% of all new steel is made from iron and steel scrap.



Construction Quiz:

What do San Francisco's Golden Gate Bridge, New York City's Madison Square Garden Center, Washington's Robert F. Kennedy Memorial Stadium, and Chicago's CNA Building have in common? Answer: fabricated and erected by Bethlehem's Fabricated Steel Construction Division. That's where the action is for people who want to help build the big ones!

From inspiration to application

Three Bethlehem researchers recently won the AIME's coveted Charles H. Herty, Jr., Award for their paper describing a significant steelmaking advance from conception to application. The team developed a high-speed automated sensor lance that measures both bath carbon and bath temperature instantaneously during the BOF steelmaking process.

Want more information?

We urge you to read our booklet, "Bethlehem Steel's Loop Course." If copies aren't available in your placement office, drop us a line. Write: Director—College Relations, Bethlehem Steel Corporation, Bethlehem, PA 18016.

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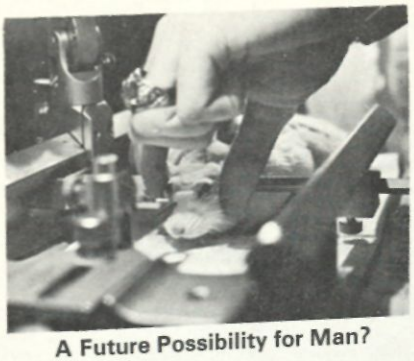

A Future Possibility for Man?

Brain Engineering

Colorado Engineer

COLLEGE OF ENGINEERING • UNIVERSITY OF COLORADO

VOLUME SIXTY-NINE NUMBER 1 OCTOBER 1972

Deans Column

Prof's Corner

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IN THIS ISSUE

STAFF

The contents of the Colorado Engineer is published by the students of the University of Colorado, College of Engineering, four times per academic year in October, December, February, and April. No part of this magazine may be reproduced without the express consent of the editor. Entered as second class matter March 9, 1916, at the Post Office in Boulder, Colorado; under the Act of March 3, 1879.

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ABOUT THE COVER: This month's cover, by Dick Sauer , depicts philosophically our feature article about brain engineering. Soon it will be possible to program the human brain much the same way as is done to a computer.

From the Editor's Desk

In this day and age, it is not uncommon to find people who are working at jobs in which they have little or no interest, simply because the pay is good. Paralleling this, we also have many students who are taking and studying subjects which interest them very little or not at all, simply because they are easy to pass, and a good way to get high grades and up their gradepoint average. This is found throughout the University.

Fortunately, this does not apply as strongly to the College of Engineering as it does to the other colleges. Engineering and other related subjects have never been considered easy (and still aren't). To take an Engineering course because it's an easy way to get a few hours credit is totally absurd. Therefore, most students in this college are here because they are interested in their fields of study.

This editorial is directed, not at those students who are pursuing their interests in these fields, but at those who have deviated their studies to other fields because of the shortage of jobs in their true fields of interest. It would be the deepest folly if I were to say that the procurement of a well-paying job was unimportant. But it is also important to see that this should definitely not be the determining factor when a job is chosen. A job, and consequently, a field of study, should be entered into because of its interest to the individual.

It should never be a "grind" to go to work, or to attend classes. There should be a very definite thirst of knowledge associated with the field of work or interest. It should even become indirectly the person's hobby.

Now is a good time for each of us to stop and evaluate ourselves and to see if we fall into one of these categories. It is all too easy to change majors because there suddenly is a shortage of jobs in that particular field. We've got to stick with it! Don't let it scare you out of doing what really interests you. If a person is good enough, and if he is really interested and "gung-ho" about it, he can always find a job doing what he wants. So keep with it.—And you won't have to get up each morning and complain about another day of classes or work.

GALVANIZED STEEL has an "ELECTRIC FENCE" to keep corrosion out of your product

The layer of zinc metallurgically bonded to steel in the galvanizing reaction is much more than just a skin deep barrier against rust. ☐ When the tough zinc coating is scratched, gouged or worn through, an electrochemical current fences the gaps and the zinc slowly sacrifices itself as it continues to protect the steel. This happens because, in the galvanic series, zinc is less noble than steel and will corrode sacrificially—fighting a stubborn delaying action against corrosion's attack. ☐ The zinc coating is bonded so firmly and uniformly to the steel that it is practically a part of the base metal and will withstand any deformation that the steel can. Galvanized steel can be formed by virtually any metalworking operation and can be readily joined by welding or soldering. When fabrication involves cutting or drilling, zinc's "electric fence" provides lasting protection to the exposed edges of the steel. ☐ Today, galvanized steel is available in finishes custom-tailored to suit your specific application. ☐ In addition, galvanized steel has the strength, hardness and heat resistance (up to 500°F) to protect your product's performance.

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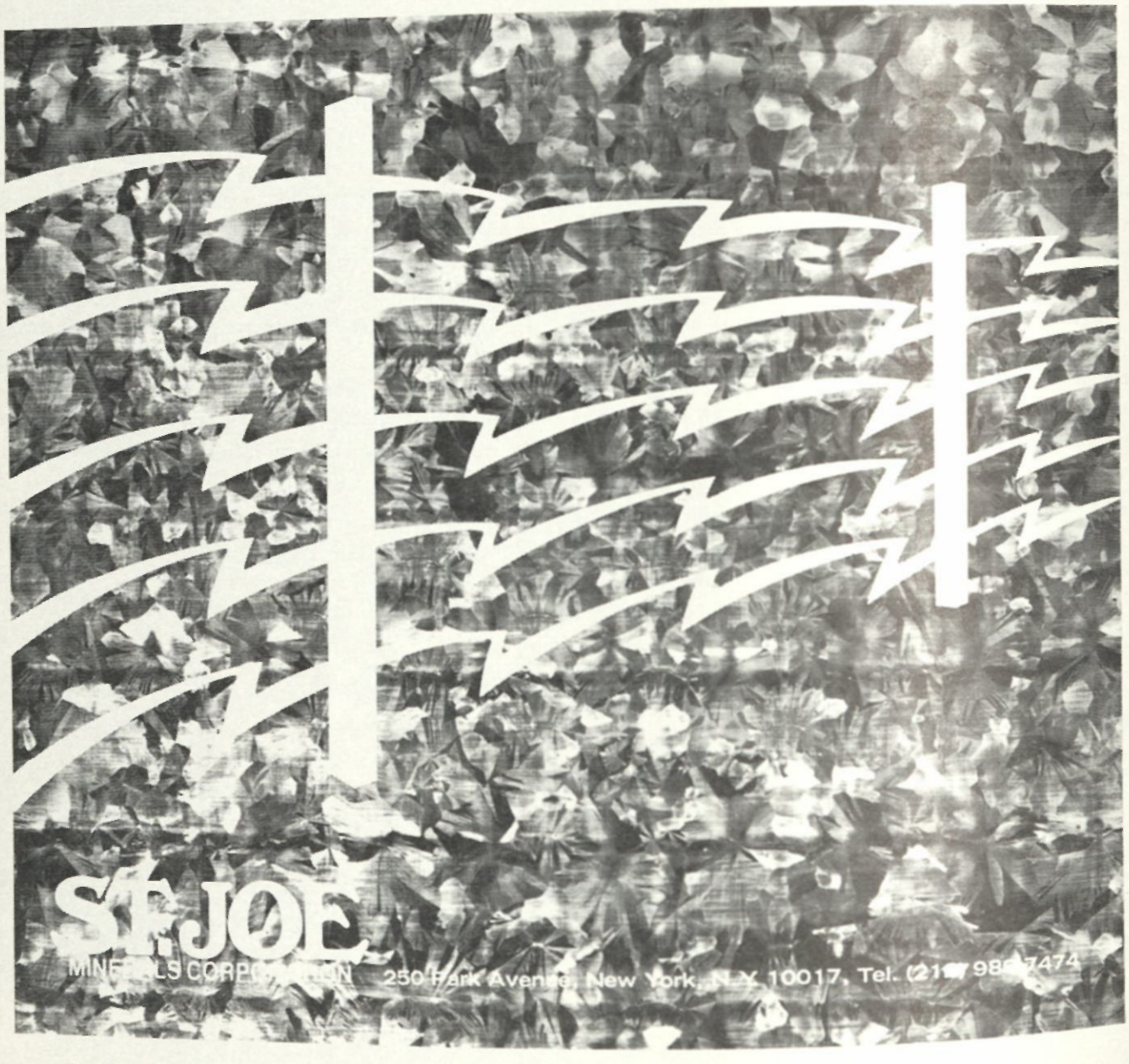


Dean's Column

October 6, 1972

I am delighted to extend a welcome to all of our engineering students as you return to our campus for the start of this academic year. I wish each of you the best of success, and I know you will be taking full advantage of this opportunity to get the most from your education. All of us on the faculty and staff are here to provide you with the best possible type of education. I hope you will feel free to come and visit with any of us if you run into problems or even if you have no problems. I am impressed with the job our Engineering Advising and Record Office is doing, and encourage you to take full advantage of its help or advice.

Our College has three mottos which I always like to call to the special attention of our students. The first is the 17-word motto of the College:

"To be what you can be, you must first and foremost decide what you want to be."

The reason you are now in engineering is that you are an example of the application of this motto. Some of you may change your minds along the way, although we hope not many of you do. In any case, I am so much prejudiced in favor of engineering that I am convinced an exposure to engineering for one month, one year, four years, or fifty years is of tremendous value to anyone.

Our second motto in the College is:

"Rights versus Responsibilities".

I am delighted to see the way our students are accepting their responsibilities in becoming involved in many kinds of campus activities other than just those related to scholastic areas. It is clear that, if we are going to request our rights in this world, we must also recognize our responsibility for appropriate involvement and support.

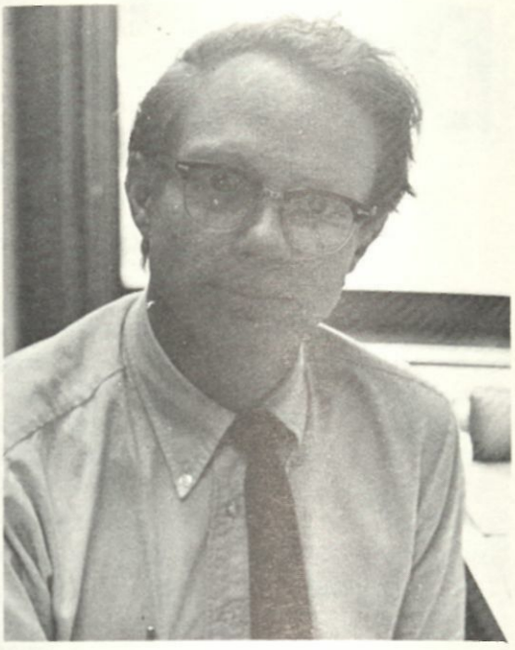
Our third motto is directly related to the meaning of the three-word motto just given. This last motto is two words which really signify what we hope is happening in our College, i.e.;

"Personally Involved" or "PI" or "3.1416..."

On page 52 of the 1972-73 Boulder Guide's University Student Handbook, the following remark is made about my views of the College of Engineering and Applied Science: "Max Peters ..... believes his school is the best and his students the brightest on campus. He may be right." This is certainly an appropriate and correct quotation which I like. My only concern is that instead of them saying "He may be right", I think they should have said "He is right".

Max S. Peters

PROF'S CORNER



by R. E. HAYES

Dr. Hayes attended the University of Kansas where he received his Bachelors and Masters Degrees in Electrical Engineering. He did research at Stanford University where he attained his Ph.D. Professor Hayes has been a full faculty member here at C.U. since 1963. He was a visiting Professor at Cornell in 1966, and did research for the Royal Radar Establishment in England in 1971. His insight into the subjects of solid state physics and semi-conductors is due to his extensive research in these fields.

The field of semiconductor electronics was, in a sense, born with the announcement of the transistor in 1948. As we near the 25th anniversary of that event, it is amazing to look around us and see how much the development of this device has affected our lives. Radio, television, telephone communication, data processing, and instrumentation of all kinds, are among the present applications that we can immediately identify as having been advanced considerably by the work on semiconductors. There is no doubt about the fact that the twenty-five years of work on semiconductor electronics has had a major influence on our present way of life. Think of the ultimate impact of modern communications on the underdeveloped countries — they know they're underdeveloped. We may not like every aspect of the semiconductor revolution, but I would say that, on the whole, the developments in this field have been beneficial to mankind.

The developments in semiconductor, or solid-state, electronics that have put us where we are now are history. Of course, the immediate question is: Will the next twenty-five years be as exciting? The large high-speed computers of today were made possible by the research and development in the field of semiconductor electronics. What's next? I don't think that it is very useful to speculate about the distant future. When you read lots of predictions about the future you are pretty sure that half of what is written is nonsense, but you're never sure just which half. However, what about the near-future, say the next ten years? What are we doing today in the field of solid-state electronics that will have an impact in the next decade?

Well, it is worthwhile to talk about these near-future possibilities, and I'll mention three different areas in which current basic work on solid-state electronics will have an influence. One of these areas involves the continued development of integrated electronics. This is the business which involves the fabrication of electronic circuits on tiny chips of semiconductors such as silicon. The production of these circuits is a very involved process in which chemists, materials people, and circuit designers all have to come to grips with the problem. It's no longer a case of an engineer with a soldering iron tinkering around. However, the benefits to be gained from this amazingly complex procedure are tremendous in those cases where hundreds of thousands of identical circuits are needed. The achievement of such minature circuits by mass production techniques means that highly sophisticated electronics will be cheap and will be found everywhere. Small computers will become cheap enough for individuals to own, and the reliance on electronic data processing will become even more widespread than it is now. We will be in a situation in which cost of the electronics is not a major concern and we will have many options such as; smaller radio and television sets, personal telephones that we carry in our shirt pocket, and access on our TV screen to desired data from a central information storage file. Present plans for cable television systems include channels for this last item. It's possible that telling the kids to look up something about elephants in the encyclopedia will take on a new meaning, thanks to integrated electronics developments going on now. Maybe we don't want that, but the point is that we are going to have many options based on this technology.

Anyone who uses the telephone knows that, a few years ago, the telephone companies underestimated the future popularity of their product. As new services become generally available by means of the telephone, such as the picture phone, data transmission, and facsimile facilities, the demands placed on these public communication systems will be even greater. All of these things exist today but not everyone has them. When everyone does we will require larger electronic systems (more integrated circuits), and transmission channels with more information handling capacity. More information capacity means more bandwidth, which means going to higher frequencies.

(Continued on page 14)

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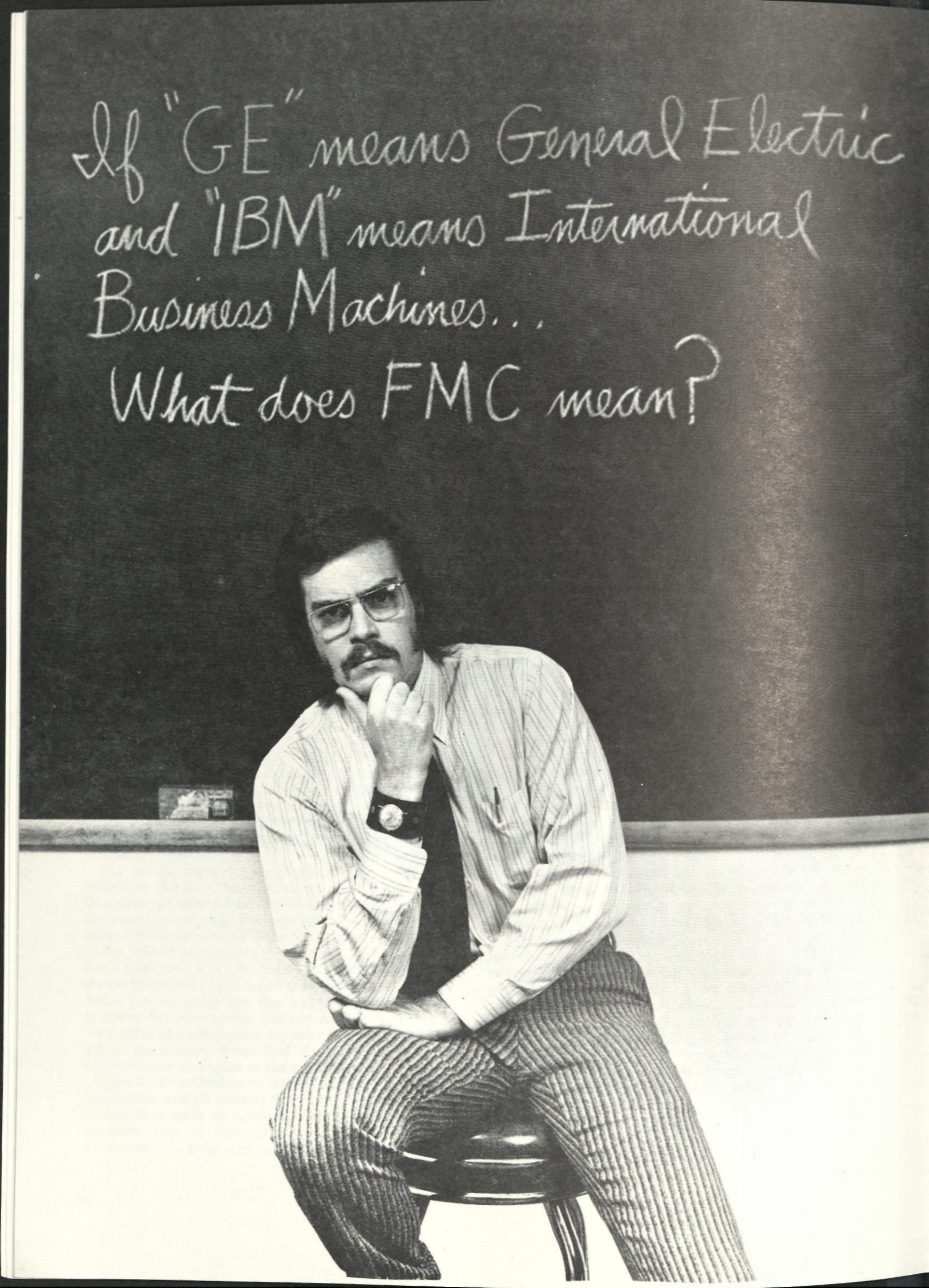
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"FMC" is the name of a highly diversified company doing thousands of good things for society—in fibers and films, machinery, and chemicals.

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Did you know that our American Viscose Division started the man-made fiber industry in the U.S.? Probably not. Yet, we're the nation's leading rayon producer, and our lines of acetate and polyester fibers keep growing.

Though our products are hard to identify, you see them all around.

We make the cellophane that wraps the hamburger you can buy at the supermarket.

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We're also the discoverers of microcrystalline cellulose, a unique excipient widely used in pharmaceuticals and special food products.

To name just a few things we're into.

If you're an engineer, chemist, or textile major wishing to make a name for yourself, see your placement officer for an interview. Or write for our booklet "Move Ahead with American Viscose" to Industrial Relations Department, FMC Corporation, American Viscose Division, 1617 John F. Kennedy Boulevard, Philadelphia, Pennsylvania 19107.

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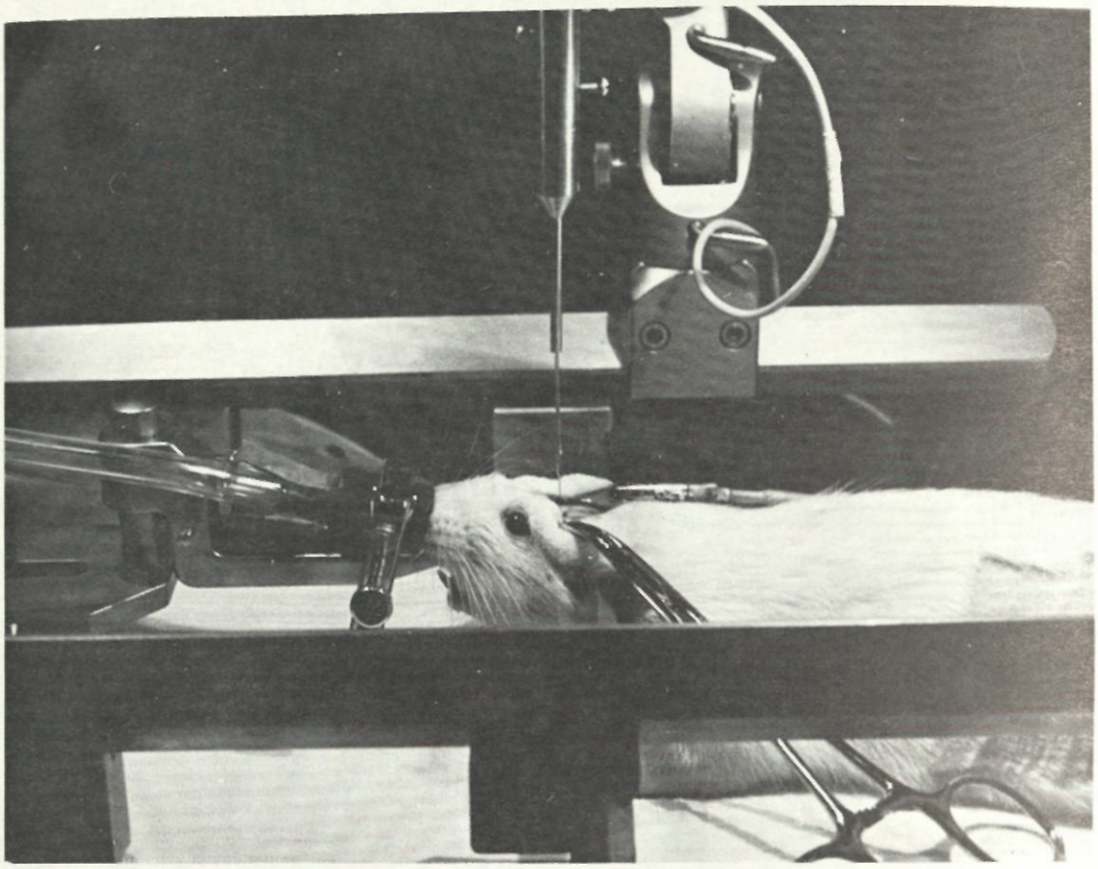
THE HORIZONS OF MAN'S BRAIN POWER

The Art and Science of Programming Man



Miniature oxygen mask keeps rats alive during experiments with drugs

by Ron A. Fattor

The BRAIN—that computer fantastic, whose billions of nerve connections exceed the number of known particles in the universe and whose electrical and chemical actions make us intelligent normal people, psychopaths, or saints—is the most complex system known in the entire universe.

Today, the concept of mind control has been hashed and rehashed until it is passe' for liberal cocktail-party conversation. Merely turn on a switch which stimulates a certain portion of your brain, or pop a pill; and *anyone* can become brave (or cowardly), happy and uninhibited (or hung-up and droll), ecstatic with pleasure (or suicidally depressant). With enough of this type of chemical and/or electrical "programming," anyone of us could be made into a cold killer who would destroy anyone in his path, or be a peaceful missionary who would devote his life to helping children. So much is common knowledge for the average well-read American.

But aside from pushbutton personality, there remain many other facets of brain research which could have explosive effects on our educational system, our way of life, and our concept of labor. For instance, take the question of learning. In the not-so-distant future, it will be possible to go directly from junior high school (at this age, the brain would be sufficiently mature to grasp abstract concepts) to a "learning center," where all equivalent high school knowledge will be learned (and learned *well)* in, say, *one* month. After which, one could receive a BS degree in Electrical Engineering in another *five* months (including physics, calculus, and Humanities, in addition to technical subjects). Add on an additional *six* months and you could have your PhD (and these are *conservative* estimates). Far fetched? Hardly. Consider the following: at present, our minds take long periods to assimilate knowledge from short-term memory (which lasts anywhere from 0 to 10 minutes after input of knowledge) to long-term storage. Much inputted knowledge which, say, we read from a book never reaches this stage but is either forgotten completely or stored at an unconscious level, which cannot be recalled by will. The only present way of getting knowledge into long-term *conscious* memory is by repetition and more repetition—an inefficient way, to say the least (not to mention time-consuming and headache-producing).

The fact that much knowledge remains hidden to us as normally inaccessible storage, has been well-proven. But such knowledge *can* be brought to the level of consciousness by electrical stimulation of proper areas of the brain (or by drugs, more of which later). This was demonstrated by Canadian Neurosurgeon Penfield in the 1950's. During one brain operation, (where it was necessary to stimulate various portions of the brain, to see

what damage had been done) when a certain area of the brain was stimulated electrically, the patient began recalling a past experience which had occurred when he was a child (the patient's current age was in the 50's)—this included a description of a room where the patient recalled extremely detailed knowledge (the location of various grease spots on the wall, and areas where the paint had chipped, etc.). Furthermore, the patient was not even aware that stimulation occurred and thought that the recollection of his childhood memories was his own idea. So, given that we have a vast storage of knowledge at any time which we cannot reach, it becomes obvious to try and reach this storehouse and make it available to our conscious state—which might be accomplished by pushbutton electrical stimulation to the right portion of the brain (via an electrode implanted surgically and wired to a button on, say, the wrist). And if we are *AWARE* of this knowledge, even while learning it, there would be no need to repeat a page in a book to "refresh our memory"—also, since background knowledge and total recall would help eliminate confusion due to forgotten basics, learning new material would become far more efficient.

As an alternate to (or perhaps a compliment to this), we might also make use of the fact that material learned just before sleep is usually remembered to a greater degree than material learned in the morning before a day's work (the reason being that, in sleep, far less distracting, incoming stimulus is present; therefore, consolidation of knowledge to long-term conscious memory can occur far more quickly and efficiently).

Since electroanesthesia already exists, it may prove advantageous, after studying for, say, 15 minutes, to "switch off" (via electroanesthesia) for a short period of time, to allow the knowledge to be assimilated before proceeding to new material (and, of course, the mind would be greatly refreshed, and its short-term memory input cleared for new material, as an added bonus).

But, of course, it matters little to say you can have total recall if you don't really give-a-damn about the subject to begin with. But the means to solve *this* problem is already existing—and is cheap and comparatively simple—which leads us into the next section on drugs.

"SMART PILLS"—THE CHEMICAL ANSWER TO STUDY HABITS

Ever wonder *why*, after studying for hours for an exam and downing coffee (or popping No Doze) to stay alert, you go into the test the next morning and just *can't* seem to remember what you studied the night before? (It's the same old story: "But I *knew* that material"!). Possibly your poor score was due to lack of sleep, cramming, or just too much tension—but, just probably, you *might* have scored a lot higher (and been a lot less frustrated afterwards) if you would have downed another cup of coffee before taking the exam—*even if you felt refreshed and had a good night's sleep.* Why? Simply this—it has been found that *learning* under the influence of some drug (a stimulant such as caffeine) *also requires that, in order to recall what you have learned, you must be under the influence of the same drug you took while learning the material.* This is referred to as "drug dependent" learning, and it varies with the type of drug taken, the dosage, and the individual. Now, applying this to a broader area, *it has also been shown that drugs can induce mental states appropriate to studying certain subjects.* For example, if a group of students is given some mild psychoanaleptic drug (i.e., caffeine) and then intensely drilled in ~~math~~ until the drug's effect wears off, and this is repeated for many days in succession, *the mind begins to associate the drug with a state of mind needed to study math.* (This is just another form of a very old psychological method known as "*Classical Conditioning,*" most commonly associated with Pavlov's experiment with dogs. This experiment was done by pairing a bell-sound with the smell of meat for many times in succession—and each time meat was brought in, the dogs salivated. After awhile, the meat was removed and only the bell sounded—and the dogs continued to salivate in response only to the bell sound, having come to associate the sound of the bell with the smell of meat).

Of course, many applications of this technique can be seen. If you dread studying for that gruesome math exam tomorrow, merely pop the proper pill and you'll soon be as eager to study math as to read *Playboy* (well, maybe not quite). There is one hitch, however; you would probably have to increase your dosage levels of the drug, to get the same degree of "smartness," since tolerance to the drug would develop—and this could lead to all types of physiological (and psychological) problems (not to mention drug addiction). So, for the present, it's still safer to study the old hard way. But, as research in psychopharmacology continues, you may one day find an advertisement in the local college paper, telling how you, too, can now be made an enthusiastic student in math by merely attending evening "conditioning classes" (much as you might learn speed-reading from Evelyn Wood), and using some drug designed for this purpose. And when that day comes, students will find enthusiasm for a subject as close as the corner drugstore.

SECOND-LEVEL MONITORING: THE TIME-SHARE SYSTEM OF THE BRAIN?

The Psychological revolution contains many facets—behavior control and modification have already been described. But also, there are actions of the human mind which occur *naturally* and, if cultivated, could revolutionize our concepts of labor and existence. One of the ~~molt~~ exciting is the prospect of using "Second-Level Monitoring" (SLM), to let us work at a nondemanding job, requiring much repetition and simultaneously being

(Continued on following page)

able to solve problems in calculus or learn some new subject. The basic concept behind SLM is the theory which states that the human mind is like a computer, constantly seeking "new copy" and novel input. This theory also assumes the brain has a certain "equilibrium level" of consciousness of novel events and will strive to mintain such a level. *Too much* novelty per unit time, and the mind will go into a state of "future shock" (so adequately described by Alvin Toffler), due to the overload. *Too little* novel stimulus (or too much novel stimulus, which is vague and apparently not important) and one feels bored. Too much harsh, demanding stimulus, and the mind will demand an escape. For these cases, the brain will "switch on" to daydreaming—providing a comfortable self-generated source of novel input, which can alternatively soothe, refresh, or provide excitement (this is just one of the theories as to why daydreaming occurs—in actuality, it may serve several functions).

So, daydreaming occurs—but this does not necessarily imply that the ability to do dull and repetitive work stops. And SLM *is* being able to exist on *two* levels at once: one level acting in a programmed, repetitive, unchallenging way, and the other level thinking out solutions to problems, dreaming of your favorite girl, etc. As a practical example of SLM, it has been noted that highway commuters who drive one route constantly soon find that sharp, driving-alertness becomes *routine response* as they become accustomed to all the sights and sounds along their driving route. Now, if these same drivers start out for home after a tiring day and traffic is light (no external demanding stimulus), many of them will, once on the freeway, daydream of some situation which provides a mental escape from the duties of the office. Yet, *while daydreaming*, they will change lanes (after looking to make sure the path is clear), signal, slow down for braking cars ahead, etc.—in short, perform fairly complex responses to stimuli of the average highway during undemanding hours—and yet, if asked to describe what actions they performed, they will have *no conscious recollection* of any details of the journey—other than a vague awareness of passing certain buildings or areas along the route. Naturally, such abilities, in a controlled environment, could have fantastic dividends in more efficient use of time, elimination of boredom, frustration, etc.

Several theories exist to explain SLM. One claims that our levels of attention switch rapidly (like a time-share system), back and forth, from monotonous reality to the daydream and back, relying, for the most part, on programmed responses to handle the demands of the external world. Other theories are based on the premise that two simultaneous levels of awareness exist, both on the conscious level, but at different levels of detail and attention. Evidence at present is inconclusive. In the example of the commuter, if a novel stimulus suddenly presents itself (a flashing red light on a fire engine, for example), the driver will "snap out" of his daydreaming mode completely and focus his full consciousness on the emergency situation—which shows the sub-level of attention can rapidly shift to full-awareness level, but interpretation of this can be based on either theory, or a combination of both. Hopefully, Psychological research will elucidate the mysteries surrounding SLM; and when this phenomena is understood, cultivation of this capability may lead to unprecedented, new efficiency levels of brain operation for learning, working and the enjoyment of existence.

THE MAKING OF A GENIUS

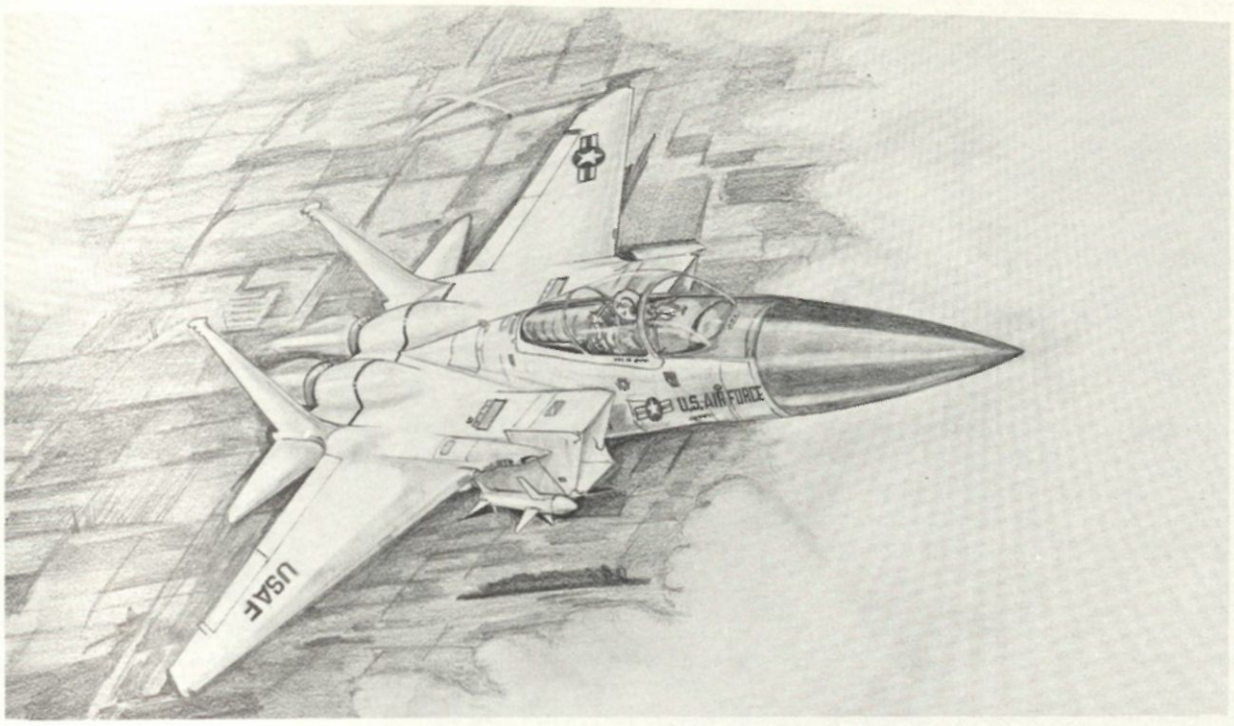
Whenever most of us speak of Einstein, Michelangelo, Edison, or A. G. Bell, we speak only in terms of wonderment at their great intellect and creative imagination; and most of us put such people on unapproachable mental pedestals. "They were geniuses; I could *never* be as smart as they were" is the common statement. But what *really* determines a genius? What makes such a person so special? Sheer knowledge? By this criteria a computer should reign supreme with its capacity for "remembering" sheer numbers of facts and formulae. Brain size? Autopsy reports show that many genius's brains were no greater in size than Mr. Joe Common and histological analysis reveals no unusual numbers of extra interconnections among nerve cells.

What does, in fact, make one man a genius and the next man a mediocre technician? Recent psychological research indicates that philosophical outlooks on life, feelings about society, appreciation for certain forms of music, and, of course, the environmental circumstances: these are just as important in the making of a genius as any academic study of the sciences. While the latter may provide knowledge of the area, the former facilitates - and even provides - the mode of thought necessary to *use* such knowledge in a creative and daring way. Furthermore, the exact criteria which are necessary for brilliance vary from field to field. Naturally, if we reach the point of fully understanding how to produce a "genius" in, say, physics, our method of research would change drastically; and such people may be produced on demand, to meet certain industrial requirements for new solutions, or to further knowledge in a certain area. Since such people would have a much higher probability of producing startling advances in science than the average PhD who now gets a sheepskin, they would be in great demand in teaching, research, and industry. In fact, admission to a school specializing in "genius" orientation for a given area, may become more coveted than admission to medical school for the future undergraduate contemplating a challenging career.

In closing, it has often been said that the "Psychological Revolution" will be far greater in its effects on man than all the previous "Revolutions" in Physics, Chemistry, Biology, and Political Thought combined. This is no overstatement. When we consider the potential benefits and problems which will be conferred upon man by increasing knowledge of the brain and man's behavior, the problems of the A-Bomb, Pollution, Sperm Banks, and Space Exploration will be trivial in comparison.

The greatest challenge to mankind in the future will not be space, but man's own mind. Medicine has improved man physically—psychology seeks to do so *mentally*—but here we must define what is desirable, what is good, what is evil—and answers to these questions may be impossible for mankind to give. But as knowledge progresses, someday, *someone* will use this power. The question is, can we insure it will be used for good? We may have an efficient society with no poverty of discontent, but what if the price involved is a loss of man's free will? Would it be worth the price?

F-15 AIR SUPERIORITY FIGHTER UNVEILED



ANDREWS AIR FORCE BASE, MD. — The Air Force recently unveiled its new F-15 air superiority fighter in ceremonies at the McDonnell Douglas plant, St. Louis, Missouri. The aircraft is designed to meet the composite threat of current and projected enemy aircraft in the post-1975 time period.

The first F-15, painted light blue, was displayed shortly before noon. Maj. Gen. Benjamin N. Bellis, F-15 System Program Director at the Air Force Systems Command's Aeronautical Systems Division, Wright-Patterson AFB, Ohio, said the reason for the color is functional. . .camouflage of the aircraft.

Its tactical missions will be fighter sweep, escort and combat air patrol; the F-15 must be able to acquire, identify, engage and destroy enemy aircraft in either contested or enemy airspace, and in an enemy-controlled radar environment.

The F-15 is a fixed wing, single place aircraft in the 40,000-pound class. It is 63 feet, eight inches long, with a wingspan of 42 feet, eight inches. It is composed of 35.5 percent aluminum, 26.7 percent titanium and 37.8 percent composites and other materials.

The design of the F-15 features twin, fuselage-mounted F-100 advanced turbofan afterburning engines, built by Pratt and Whitney Division of the United Aircraft Corp., East Hartford, Conn. Each provides approximately 25,000 pounds thrust and utilizes advanced technology and lightweight materials.

The high thrust-to-weight ratio provided by the engines and its low wing loading enables the F-15 to achieve high maneuverability necessary for air-to-air combat.

The maneuvering performance of the aircraft has been maximized so that the F-15 will have a clear advantage over potential adversaries at speeds ranging from less than 200 knots to speeds in excess of twice the speed of sound and at altitudes from sea level to above 60,000 feet.

While the F-15 has a top speed in excess of Mach 2, a high-speed, high-altitude capability is not in itself the most important consideration in designing an air superiority fighter. General Bellis explained that air battles usually do not take place at extremely high altitude. The high, fast aircraft normally must descend and engage in combat at lower altitudes to be effective. Once in this arena of battle, the large, relatively unmaneuverable aircraft cannot compete with the highly maneuverable F-15.

The F-15 is armed with medium and short range missiles, and an internally-mounted Gatling gun. The primary sensor in the avionics system is the attack radar. The radar permits long-range acquisition of targets and enables the pilot to make computations and flight maneuvers to down enemy aircraft in adverse weather. It also directs the launch of missiles and provides range, steering and firing data for the gun.

The F-15 air superiority fighter was born of competitive hardware prototyping and head-to-head engineering competition.

Design of the F-15 began in 1965 with the feasibility studies of the F-X "Air Superiority Fighter," to meet the requirements of the post-1975 time period. A significant number of trade-off studies were run early in the program to determine such factors as aircraft size, swing wing versus fixed wing, mission mix and optimum crew size. More than 500 conceptual variation analyses were performed during a three-year study effort to define characteristics required to provide the air superiority excellence needed for the F-15 fighter aircraft.

The total number of wind tunnel hours is 23,000 or four times the amount of similar testing completed on the F-4 aircraft.

Profs Corner

(Continued from page 6)

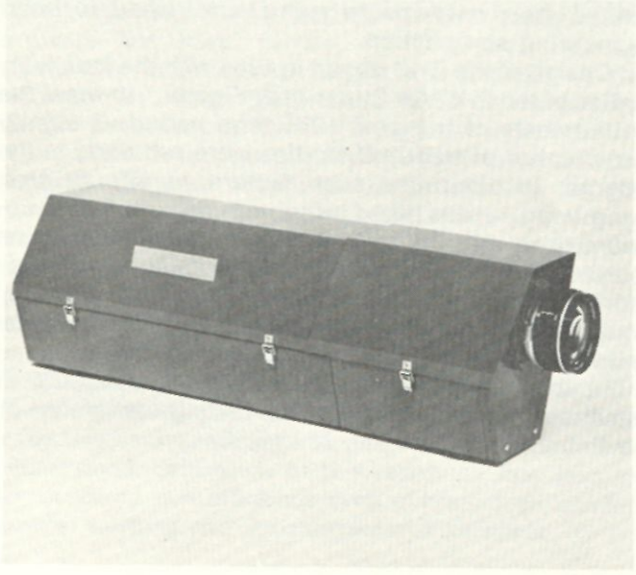
Presently, the transcontinental telephone traffic is handled by microwave links at a frequency of 4 or 6 GHz. The plans for the late 1970's calls for millimeter wavelength (40 to 100 GHz) transmission links which will each handle a quarter million two way voice channels. Then, as picture phones, etc., really catch on beyond the 1980's we will have to shift up to the optical frequencies with light links that will each handle 100 million 2-way channels. The millimeter wavelength systems will be based on semiconductor devices that have been worked on around the country, including here at C.U., during the last seven years or so. Improvements are still going on, for example, this last year I worked with a group in England on a semiconducting material that shows considerable promise for millimeter wavelength applications. The optical systems are a long way off yet and the ground work is being done now.

For example, there are several research projects in the Electrical Engineering Department that have as their goals the development of optical waveguiding structures and signal processing components. This work involves the understanding of the optical and electronic properties of various materials as well as the solution of sophisticated electromagnetic waveguiding problems. Part of this effort involves understanding and applying the properties of anisotropic materials. Work like this sometimes appears to be far removed from practical applications, but one day a businessman may carry out much of his activity from a communication center in his home as a result of a lot of people doing what might appear to be "impractical" work. At the least, we will see the continued decentralization of business centers in the country. There will be little need for a center like New York when you can, as common practice, push a few buttons and speak to, see, and pass papers and data to colleagues spread around the country. I'm sure that the increased use of data processing and communication systems will continue to have a significant affect on our lifestyles.

Another area that we are engaged in here at C.U. is that of microwave devices. The continued development of some of these high frequency semiconductor devices will make things like miniature radar systems reasonable. Already radar systems employing oscillators, made of the semiconductor gallium arsenide, are being tested on automobiles. It is clear that several large companies think that radar collision avoidance systems will be standard equipment on automobiles in the near future. These semiconductor devices are also finding applications in usual radar systems such as in aircraft, and in unusual places such as short-hop communication links and burglar alarms. One wonders about radar for blind people; it's one of the things that is becoming possible. Indeed, a form of optical radar has recently been tested as an aid to the blind.

So, we see that fundamental technical developments going on today will most certainly have an affect on the options for the mode of life that we have in the future. This is constantly going on, and in ways that are often unexpected. Down the hall is a microwave oven that will heat a chili-dog for me in 20 seconds on those days when I have to gulp my lunch between classes. When the microwave tubes like the ones in that oven were first developed for radar applications, no one thought of microwave cooking. While it is not altogether obvious that my chili-dog is an improvement, I'm fairly certain that Bardeen, Brattain, and Shockley didn't envision the tremendous improvements brought about by the computer revolution when they invented the transistor. If you don't like computers, there are many other examples in fields like medical electronics, industrial processing, trans-ocean TV links, etc. The message from the past is that the unexpected applications will be among the most useful of all.

You have noted, no doubt, that I haven't mentioned environment, pollution, social unrest, etc. These are serious problems that we are facing today, and technology is on occasion blamed for the present state of affairs. This is not quite accurate. Technological capabilities, such as we have in the solid-state electronics field, provide us with choices for action. Certainly, some of our actions have been ill-advised. However, I think that as we learn to exercise our choices wisely, based upon our inventory of technical capabilities, and an improved understanding in the social-political sphere, we will overcome many of these pressing problems. The ingredients for the solutions are there, and the determination to exercise them is just coming. In general, I am optimistic about our future, and feel that our technology will contribute greatly to it.



The new TEM low-light-level television camera line from the Westinghouse Electronic Tube Division, Elmira, N.Y., has models capable of operating at light levels as low as 5 x 10^{-7} footcandles — lower than any other standard camera. The four TEM models come in one-piece packages that use either an EBS (electron bombarded silicon) or an SEC (secondary electron conduction) camera tube, with or without an image intensifier. All necessary power and control circuits are in one package with the tube.

These compact cameras are ideal for applications in astronomy, research and testing. Some typical uses are: with telescopes to observe faint stars, with electron microscopes in medical and biological research, with flight simulators to vary landscape visibility, as nondestructive test equipment to detect defects invisible to the naked eye, and for quantitative spectrographic analysis.

Features include automatic gain control to compensate for variations in scene illumination, a 525 scanning system with random interlace or 2:1 fixed interlace to give a high-quality picture, and all-solid-state circuitry (except for the tube, of course) to give dependable operation and keep down size, weight and power requirements.

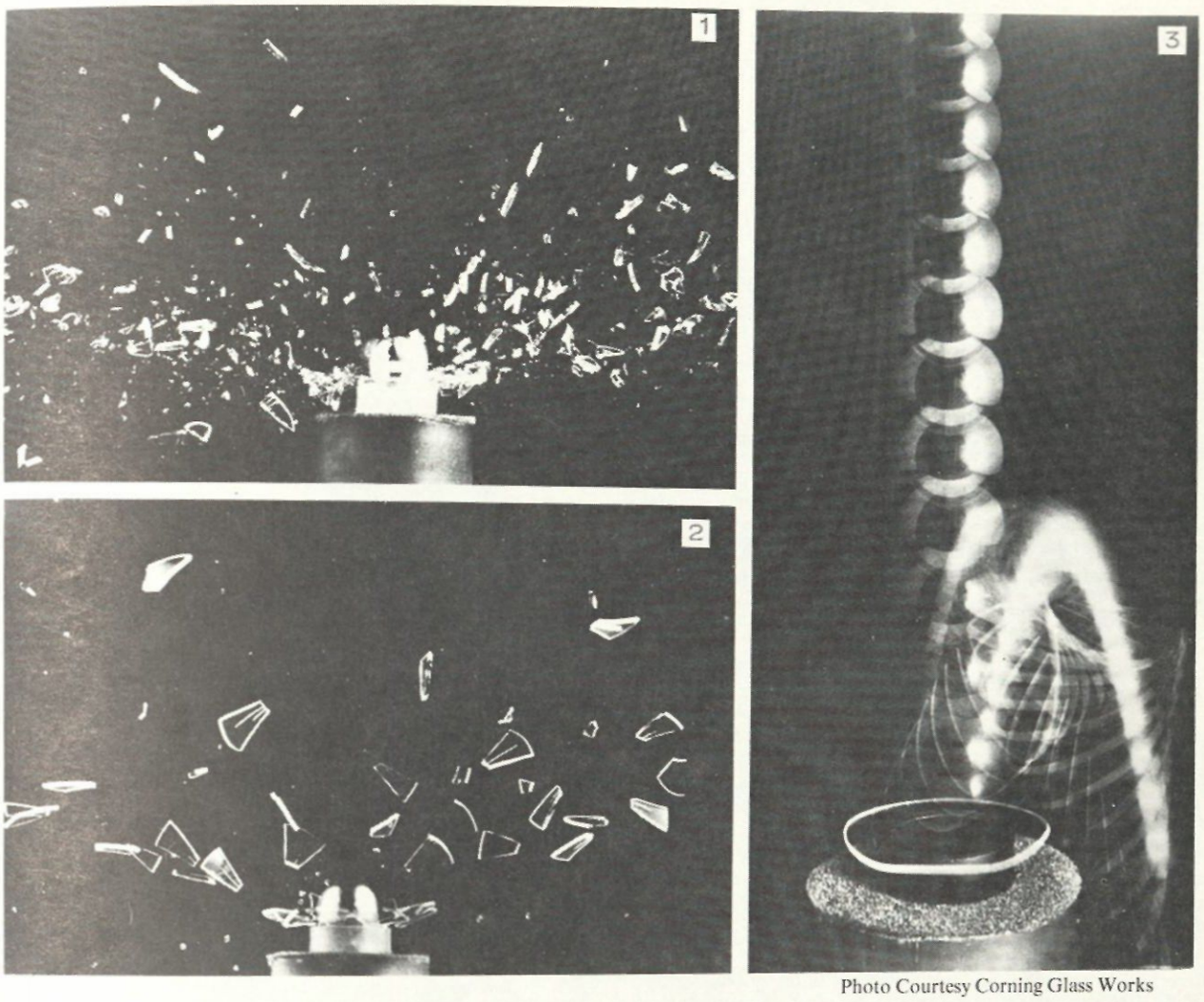
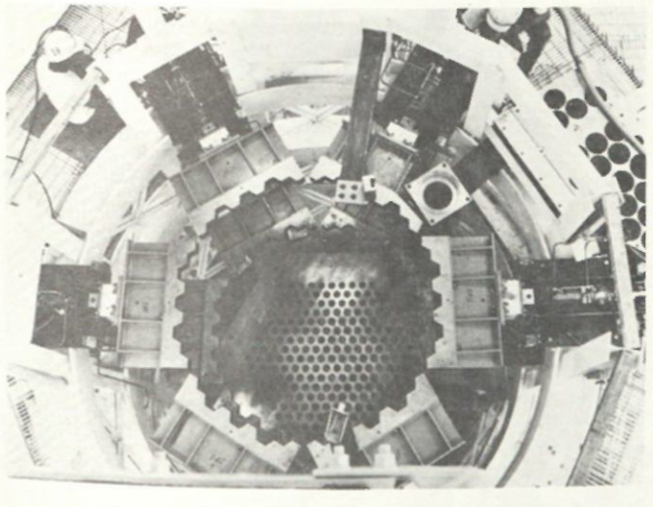


Photo Courtesy Corning Glass Works

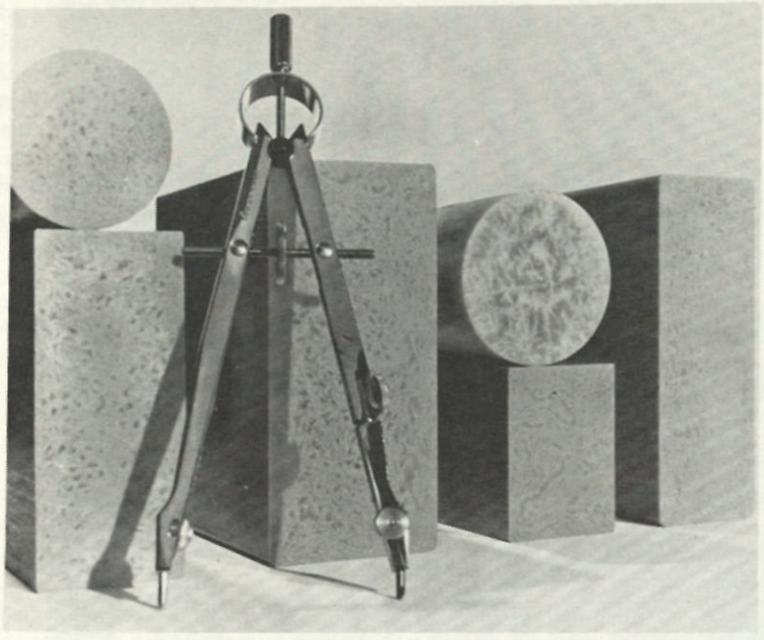
WATCH THE BOUNCING BALL! Rdgulations of the U.S. Food and Drug Administration require that all new eyeglass lenses withstand the impact of a 5/8-inch diameter steel bll dropped to inches. Heat-tempered glass and plastic lenses usually pass this test, but now Corning Glass Works has developed a chemically strengthened lens that is twice as strong as most bnnventional lenses. To demonstrate impact resistance of the chemtempered lens, Corning dropped one-inch diameter steel balls on each type of lens. Photo 1 shnvr the heat-tempered lens as it shatters from impact of the ball dropped 55 inches. Photo 2 shows a plastic lens breaking from impact of the ball dropped 60 inches. In photo 3 the ball hits a chemtempered lens from a height of 10 feet and bounces away without damage to the lens.

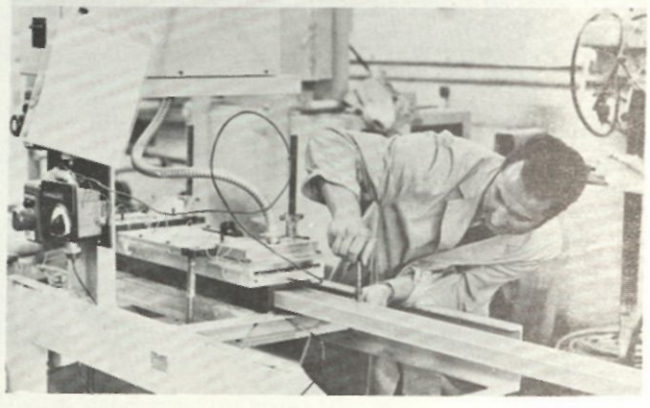


This Fast Flux Test Facility (FFTF) core mechanical mock-up has been installed in the high-temperature sodium facility at the Hanford Engineering Development Laboratory (HEDL). This full-scale test facility will enable HEDL engineers to test in-vessel handling machine operation, instrument tree insertion and removal, and methods of holding fuel bundles in the core region of the FFTF.

The Hanford Engineering Development Laboratory is operated under contract to the Atomic Energy Commission by Westinghouse Hanford Company, a subsidiary of Westinghouse Electric Corporation.

NEW WESTINGHOUSE PROCESS ALLOWS PULTRUSION OF THICKER STRUCTURAL CROSS SECTIONS





Production of pultruded beams with larger cross sections than previously possible is the result of a new resin-catalyst system developed by the Westinghouse Electric Corporation.

The company is now producing the shapes for structural applications that require the special properties of pultrusions made of fiber-glass reinforced polyester resins — high strength combined with chemical and corrosion resistance and nonconducting, nonmagnetic electrical properties.

With cross sections measuring 2 inches by 4-1/4 inches and even larger now easier to fabricate, Westinghouse expects a steady growth in the use of pultrtded materials for structural applications where metal can't be used because of chemical or electrical problems, and wood isn't strong enough.

Typical applications of Westinghouse Polyglas® pultrusions include racks above electroplating tanks, lift rods in power circuit breakers, tool handles, marine structural members, ladders, guard rails, and antenna structures.

Pultrusion is a continuous molding process in which a reinforcement material — commonly fiberglass — is pulled through a resin bath and then through heated dies where polymerization takes place. The material exits from the dies as a fully cured, thermoset-formed shpe. Since the process is continuous, costs are low relative to other methods of producing thermosetting, fiber-reinforced parts.

While the process can produce pieces of any desired length, cross-section size has been limited bdcause heat given off by the hardening resin tends to crack thick parts. This problem has been reduced by careful control of the processing conditions and the use of a rpecial polyester resin-chemical catalyst system developed at the Westinghouse Research Laboratories. The proprietary system uses commercially available chemicals.

Though some standard shapes are stocked, most are formed to order. For nonstandard shapes, Westinghouse specializes in quick delivery with low tooling costs.

For more information on Polyglas pultruded products, write Westinghouse Electric Corporation, Industrial Plastics Division, 1585 Lebanon School Road, West Mifflin, Pa. 15122.

PR-31740 — One of the larger cross sections to be made by the Westinghouse pultrusion process — a 1-1/2-inch-by-3-1/2-inch piece for making lift rods in a power circuit breaker — is shown in production here at the Industrial Plastics Division's pultrusion plant in West Mifflin near Pittsburgh. TOP: All the glass fibers shown are used to form the continuous beam, shown exiting the die at left. BOTTOM: A quality control check verifies thickness of the piece.

Unidentical twins.

What do you call two stereo systems that have identically the same insides, but not the same outsides?

Well, you call one a Sylvania compact stereo system. It's stacked and compact with tuner/amplifier, turntable, and tape player all in one unit.

And you call the other a Sylvania component stereo system. Each unit is separate so you can spread it around any way you want it.

Inside, though, they're the same. Both have an RMS rating of 12.5 watts per channel (20 watts IHF) with each channel driven into 8 ohms. There are identical FETs, ICs, and ceramic IF filters in the AM Stereo FM tuner/amplifiers. Both offer the same switchable main and remote speaker jacks, headphone jacks, aux jacks, tape monitor, and built-in matrix four-channel capability for the new quadrasonic sound. The turntables are Garrard automatics with magnetic cartridges and diamond styluses. The 4-track stereo record/playback cassette decks are the same. And both air-suspension speaker systems contain two 8-inch woofers and two 3-inch tweeters.

So if they're the same, how come they're different?

Because different people want the same great stereo sound different ways. So we give it to them.

Come on down to your Sylvania dealer's for a look and a listen.

Then you can pick the shape you want as well as the sound you like.

GTE SYLVANIA

Sylvania Entertainment Products Group, Batavia, N.Y.

HOW CAN A SMALL PIECE OF WIRE HELP SAVE A PATIENT DURING SURGERY?

General Electric engineers and medical researchers have come up with a very interesting piece of "wire."

It's an electrode wrapped in a membrane that's highly permeable to CO_2 gas. Yet tiny enough to fit inside a needle and be inserted into a person's blood vessel.

That's a neat piece of engineering. But that's not why it's important.

The GE sensor permits a new method of measuring the pCO_2 level in human blood... one of the most important indicators a doctor has for determining a patient's condition during major surgery.

It eliminates the need for drawing a blood sample, then sending it to the hospital lab for a pCO_2 analysis. That can take time. Sometimes more time than a critically ill patient can afford.

The new GE blood gas analyzer gives a doctor continuous, instantaneous pCO_2 readings. So it can warn him of developing trouble. And give him the time to respond.

It's a good example of how a technological innovation can help solve a human problem.

That's why, at General Electric, we judge innovations more by the impact they'll have on people's lives than by their sheer technical wizardry.

Maybe that's a standard you should apply to the work you'll be doing. Whether or not you ever work at General Electric.

Because, as our engineers will tell you, it's not so much what you do that counts. It's what it means.

GENERAL ELECTRIC