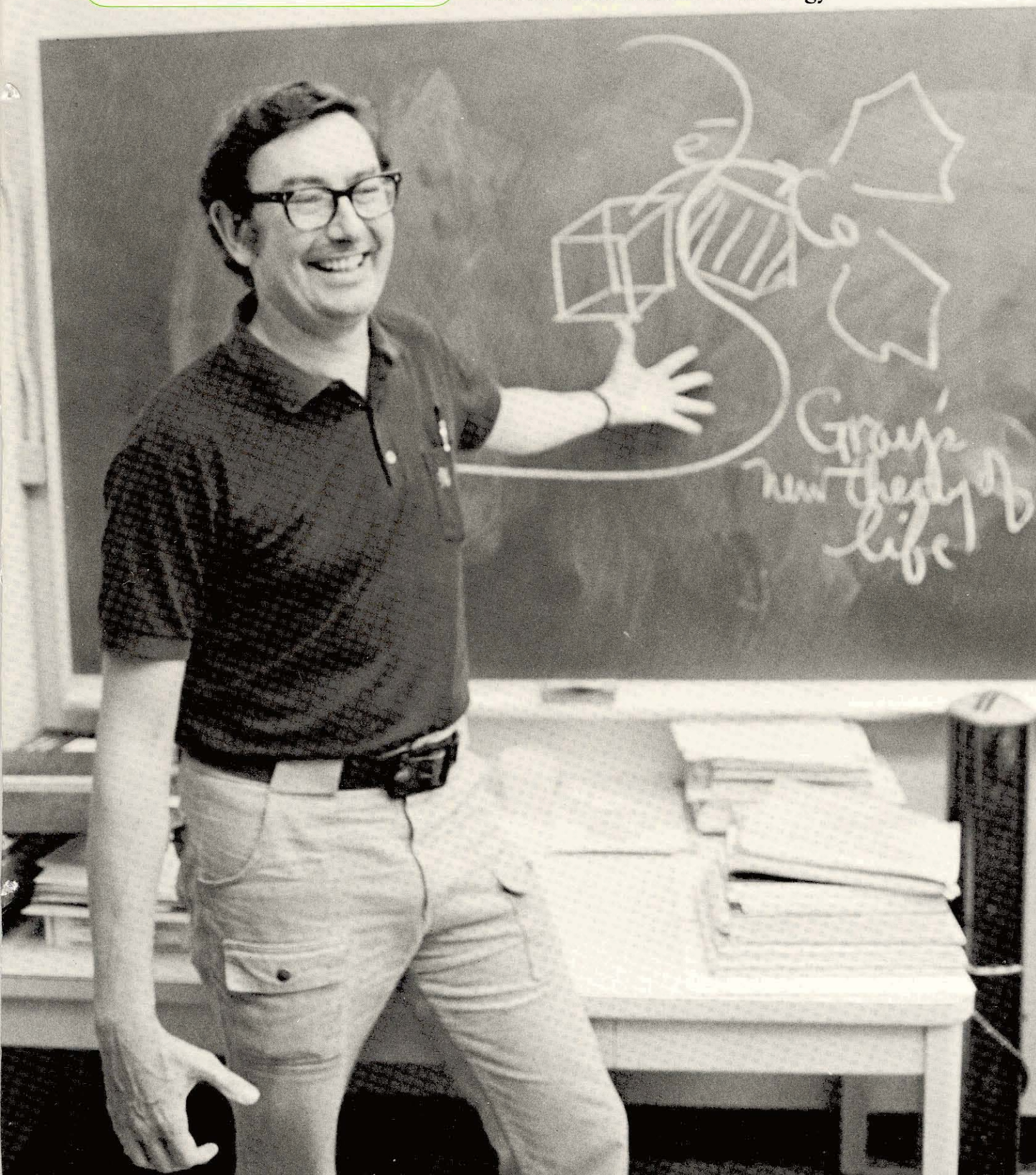
Engineering and Science

October-November 1975
California Institute of Technology



Frank DeCaria has helped provide a better home for thousands of fish in Old Hickory Reservoir.

Frank DeCaria holds a BS-ChE from West Virginia University. He's twenty-four years old and has worked at Du Pont's Old Hickory plant near Nashville for just over two years now.

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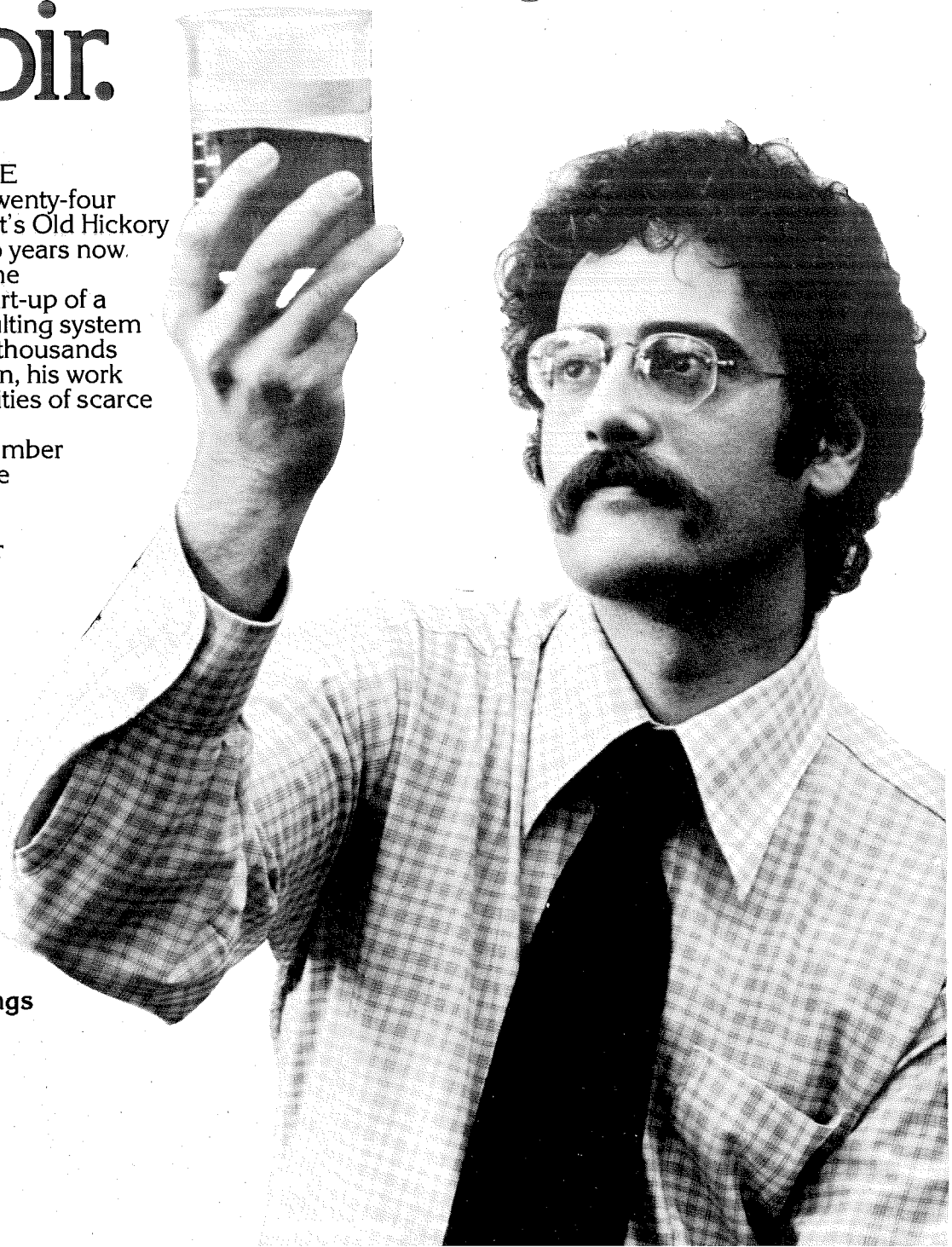

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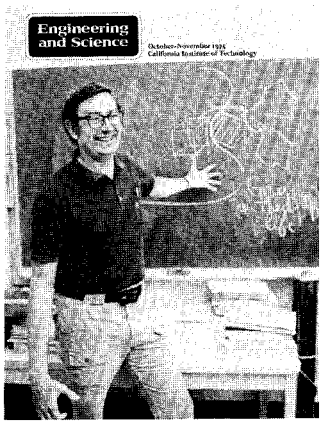
Engineering and Science

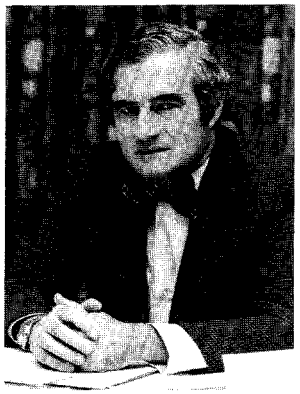
October-November 1975/Volume XXXIX/Number 1

In This Issue



Gray Matters

On the cover—Harry B. Gray, professor of chemistry, who has just been appointed William R. Kenan, Jr. Professor at Caltech. Gray received another honor from the Institute last spring when Caltech's graduating seniors asked that he deliver their commencement address—which he did. Because we are running this high-spirited talk, "The Chemistry of Caltech," in this issue (page 7), we must regretfully put off until later an account of Dr. Gray's new theory of life, so prominently displayed on this month's cover.



Humanism and Science

Robert L. Sinsheimer, who has been professor of biophysics at Caltech since 1957 and chairman of the biology division since 1968, is much in demand as a speaker. He first gave "Humanism and Science" (page 10) as a talk at California State University, Northridge, on April 10, and *E&S* leaped at the chance to put his words in print.

As usual, Dr. Sinsheimer's text makes a thoughtful and stimulating article. Also as usual, the erudite Dr. Sinsheimer's vocabulary sent us at least once to the dictionary—as on page 26, for example. For those readers who share our problem we hereby provide a definition of *entelechy* as "an immanent agency held by some vitalists to regulate or direct the vital processes of an organism." It is pronounced en-*tell*-a-kee.

Joint Account

Poul Anderson, the well-known science fiction writer, reports on the launch of Apollo-Soyuz for *E&S* in "Thoughts at Liftoff" on pages 14-17, with photographs by Alan Stein, '71.

Alan, who was a professional photographer even as a Caltech undergraduate, covered the launch of Apollo 17 for *E&S* in December 1972. For the July 1975 launch of the last Apollo of all, which carried three astronauts into space to shake hands with two Soviet cosmonauts, Alan was accompanied by his good friend Poul Anderson — to our great benefit.

Born in the U.S. of Scandinavian parents, Anderson grew up mostly in Texas, then on a Minnesota farm. He majored in physics at the University of Minnesota, graduated with honors in 1948, and went to work as a free-lance writer. Though he's published more than 50 books and several hundred shorter pieces on a galaxy of topics, he is best known for his science fiction.

It is no surprise to learn that he's a member (and ex-president) of the Science Fiction Writers of America—though it *is* one to discover that he is also a member of the Mystery Writers of America and of the Baker Street Irregulars. But who could even have imagined that both Poul and his wife are active in the Society for Creative Anachronism, where he has won a knighthood for prowess in medieval combat.

Loyal Opposition

Gilbert W. Fitzhugh was graduated magna cum laude from Princeton in 1930 and spent his entire business career with the Metropolitan Life Insurance Company, becoming its president in 1963, chairman and chief executive officer in 1966. He retired in 1974, having also devoted much time in those more than 40 years to serving in a wide variety of professional and civic capacities—including the presidency of New York Chamber of Commerce, and memberships on a presidential panel to investigate the internal organization of the Pentagon and a New York State panel to develop new policies for dealing with social problems.

Mr. Fitzhugh, who now lives in Rancho Santa Fe, California, has been a Caltech trustee since 1973. His article on page 18, "Inflation—A Monetary or a Fiscal Problem?"—is a reply to the *E&S* article (February-March 1975) by Alan R. Sweezy, professor of economics, "Keynesian Economics and Inflation."

Double Entry

Caltech has a pair of biologists to whom "going home" means a 7,600-mile plane or boat trip across the Pacific to Australia. So maybe a 6,000-mile trip in the U.S. is just a jaunt to John and Rona Pettigrew.

John, assistant professor of biology, was born in Wagga Wagga, New South Wales. He got his BSc, MSc, and MD from the University of Sydney. Rona, research fellow in biology, got her BSc and PhD from the University of New South Wales.

John has already described his research on how mammals perceive their environment, in *E&S* (January 1974). In *this* issue he reports on an extraordinary odyssey that he and Rona made several years ago when John was doing a postdoctoral stint at UC Berkeley, just before coming to Caltech in 1973. He also exposes a hitherto unrevealed aspect of the Pettigrews' lives—motorcycling (page 20).

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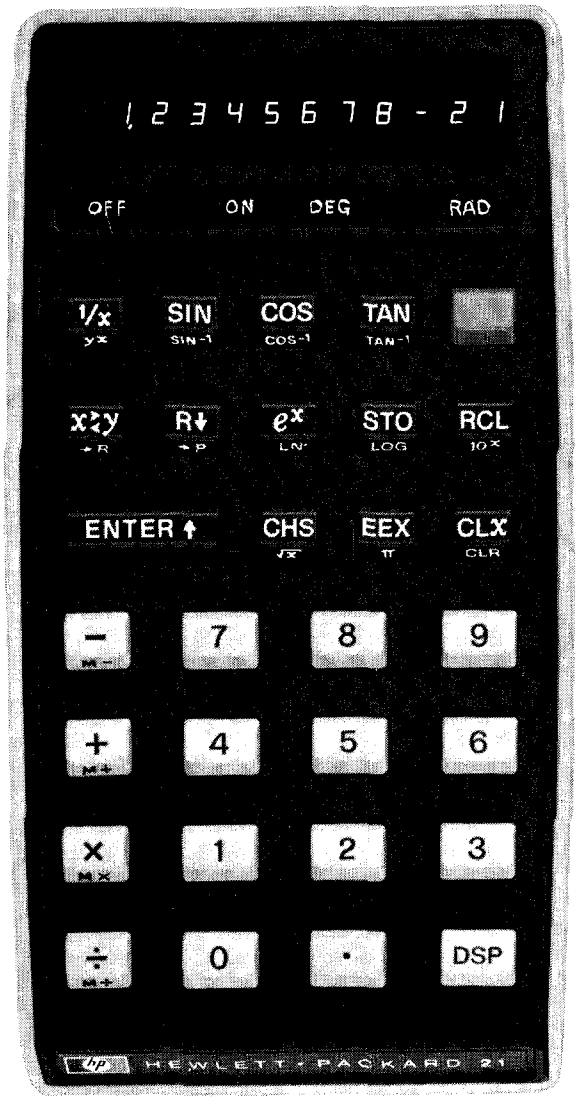

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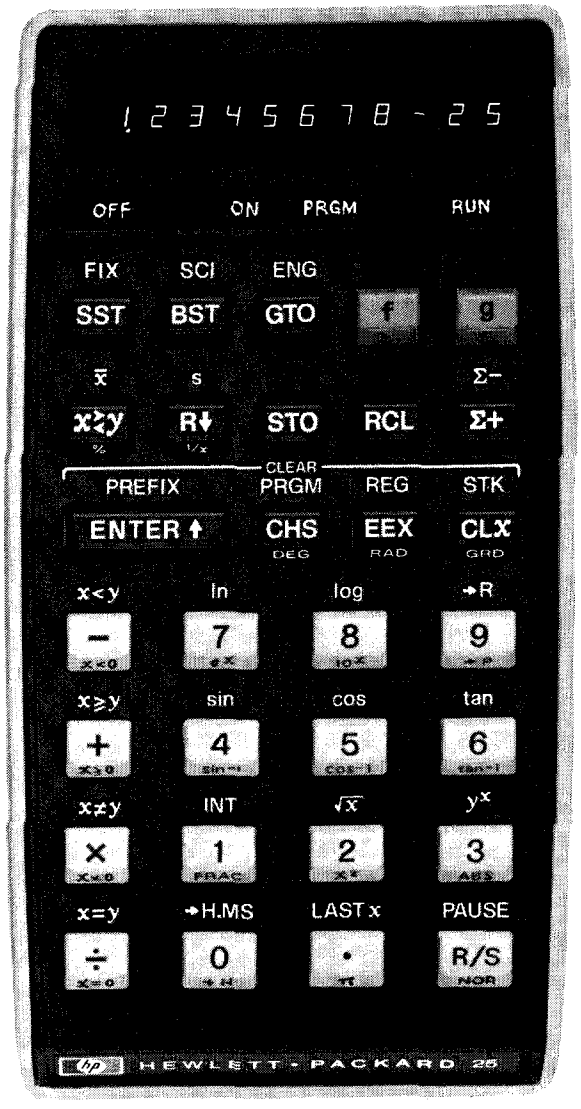

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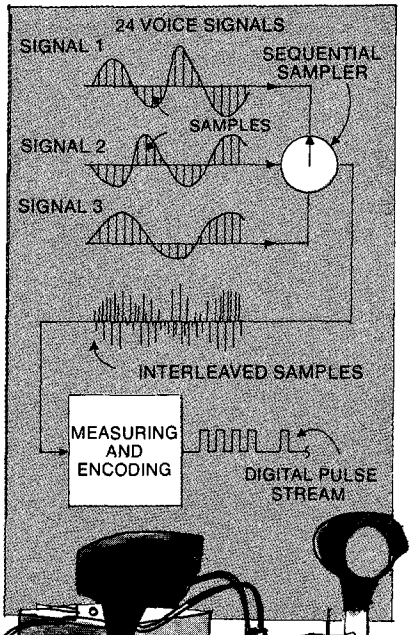
Western Electric Reports:

Moving phone calls bit by bit.



The T1 System samples 24 voice signals and encodes the measurements in binary form for transmission over a conventional pair of telephone wires as a stream of pulses.

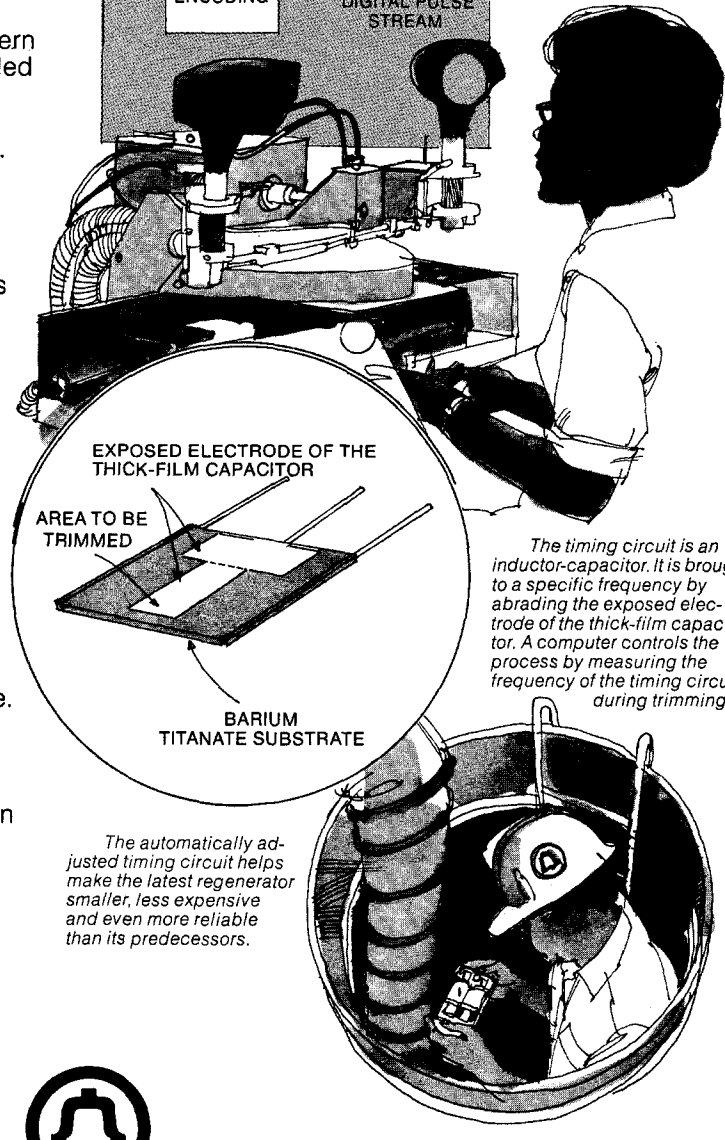
To meet the growing demand for communications facilities, the people at Western Electric and Bell Labs have developed digital techniques, which dramatically increase the number of phone calls that can be carried over existing wires.

In digital communications, a voice signal is sampled 8,000 times a second. Each sample represents the amplitude of the voice's wave pattern on a scale from 1 to 256. This measurement is coded in binary form as a series of pulses or "bits." And the code is transmitted to the receiving end where it's decoded to faithfully recreate the voice. Because this is a sampling technique, the pulses representing a number of voice signals can be interleaved. For example, the T1 System, workhorse of the Bell System's evolving digital network, transmits 24 simultaneous conversations on two pairs of wire.

Development of digital techniques has demanded close coordination between designer and manufacturer. Interleaving 24 conversations on wire pairs originally intended to carry a single voice signal meant designing the T1 System to fit the characteristics of cable already in place. It meant manufacturing components that operate with clockwork precision, since the system must transmit a "bit" precisely every 648 nanoseconds. (The time it takes light to travel about 650 feet.) And because the stream of pulses must be regenerated at about one mile intervals—often in manholes under busy city streets—the components must be extremely stable.

Engineers at Western Electric's plant in Massachusetts are working with Bell Labs on a wide range of design and manufacturing innovations. For example, previous timing circuits used in the regenerator for the T1 System were tuned manually. Western Electric engineers have developed a computerized process that tunes the circuits faster and more accurately. Meanwhile, Bell Labs has developed even higher capacity digital systems. The latest can interleave 4,032 simultaneous conversations on a pair of coaxial conductors.

Benefit: Digital communications techniques are one more way the Bell System is working to meet your communications needs reliably and economically.



The timing circuit is an inductor-capacitor. It is brought to a specific frequency by abrading the exposed electrode of the thick-film capacitor. A computer controls the process by measuring the frequency of the timing circuit during trimming.

The automatically adjusted timing circuit helps make the latest regenerator smaller, less expensive and even more reliable than its predecessors.

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Engineering and Science
October-November 1975

The Chemistry of Caltech

by HARRY B. GRAY

Caltech's 1975 Commencement Address — or How Commencement Speakers Are Chosen

Do you *really* want to graduate on Friday, the 13th? I don't know about you, but I was thinking about today being the 13th and also a Friday, and I got a little worried about giving this talk. So I did a little research.

I went over to the Institute archivist, Judy Goodstein, who knows everything about Caltech's history, and asked Judy and her assistant, Ruth Gordon, to dig up something good about the 13th of June. And so they rustled around in the old papers that are in the archives and came up with a giant deed — *the deed,* in fact, to the original plot of land that was given to Throop University by Old Man Throop *(Amos G. Throop).* The deed is dated the 13th of June 1892.

How about that?

You all know that Throop University is now Caltech. So this *must* be a good day for Caltech! We're 83 years old today, in one way of looking at it, and as all students know, what's good for Caltech is good for you. Right?

This is a grand occasion. It's so grand you must be wondering why I was chosen as speaker. Actually, I've been wondering that myself. And so I went back to Judy Goodstein over in the archives, and I said *(I'm getting to like Judy at this point),* "Judy, how does Caltech pick speakers for grand occasions? Do you have any material on this?"

Sure enough, she had lots of material. Albert Einstein visited here several times in the early thirties. He was our original Fairchild Scholar. *(He didn't know he was a Fairchild Scholar, but he was.)* And there's a lot of material on Einstein's visits, because there were many ceremonies and banquets in honor of him.

One item Judy dug out was particularly interesting. Something written by Richard Chace Tolman, who was professor of theoretical physics and professor of physical chemistry at the Institute. *(That's the last time that title will ever be used here.)* Richard Chace Tolman was involved in one of the big Einstein banquets at Caltech, and he told an interesting story about how he was chosen to be the toastmaster for that occasion.

Here's what Tolman said: "Fellow scientists, first of all I should like to explain to you the reason why I happen to be toastmaster this evening.

"Three weeks ago today in the late afternoon I was strolling back and forth on the Institute campus buried in meditation, trying to find a solution for the terrible problem of the increase in entropy that appears to be taking place everywhere throughout the universe." *(You see why I picked this passage; Tolman and I have very similar interests. I continue.)* "Just at the moment when it seemed as if I were about to get a solution for the problem, my walk was suddenly interrupted by Dr. Millikan. *(You don't know about Dr. Millikan; remind me to tell you about him sometime.)*

" 'Tolman,' he said.

" 'Yes, Professor Millikan,' I replied.

"Dr. Millikan is an older man than I am, and he always speaks to me in that informal way. He just calls me 'Tolman,' but I am a younger man than he is, so I always reply, 'Yes, sir. Yes, Professor Millikan.' "

(Now you must realize that Harold Brown and I greet each other in a much different manner. Harold doesn't even know my last name. He has a lot of trouble with people with colored last names. I continue.)

" 'Tolman,' he said, 'I think it would be a good plan if we had a dinner at which the members of the scientific staff of the Institute and the neighboring institutions could meet Professor Einstein.'

" 'Dr. Millikan,' I replied. 'I think that would be very fine for the staff members, but pretty hard on Dr. Einstein. I am sure that in the course of his life he has had to attend so many dinners in his honor that he never wants to look another filet mignon in the face. I therefore recommend strongly *against* such a dinner.'

"Two weeks ago I was again strolling back and forth on the campus and again nearly reached a solution to the problem of entropy and was again interrupted by Dr. Millikan.

" 'Tolman,' he said, 'I have been thinking about *your* suggestion that we ought to have a staff dinner in honor of Dr. Einstein, and I believe we ought to have a number of speeches at the dinner by staff members.'

" 'Dr. Millikan,' I replied, 'I think that would be fine for the speakers but very hard on Dr. Einstein and the other listeners. I therefore recommend strongly *against* any speeches.'

"One week ago today I was again strolling back and forth on the campus, and again nearly reached a solution to the problem of entropy, and was again interrupted by Dr. Millikan.

" 'Tolman,' he said, 'I've been thinking about *your* suggestion that we ought to have speeches at the staff dinner in honor of Dr. Einstein. Here is a list of speakers, and I've decided to appoint you the toastmaster.'

"That, my fellow scientists, is the reason why I am toastmaster tonight, and the reason why the problem of the entropy of the universe still remains unsolved.' "

I hate to tell you, but I was chosen to give this talk in a much less devious way *(and in a much less interesting way).* Several months ago the chairman of the convocations committee, Jon Mathews, who is also a professor of physics, called me and said, "Harry, I've got to talk to you privately in your office."

I said, "Come on over, Jon."

He came over, looked very nervous, shut the door, made sure it was shut, and he said, "Harry, you were the third choice of the students this year. We want you to give the commencement address. Will you do it?"

I said, "I'll do it."

He never told me who finished first and second. But I suspect it was either Diana Rigg, Burt Reynolds *(who's my main competition),* Linda Lovelace, or possibly Mr. Spock. At any rate, I'm very delighted and honored to be able to speak to you. I've had most of you in class, as you know, unfortunately. Most of you were in Chem 1, in fact. Let's hear it for Chem 1! *(I thought I flunked most of you, but obviously there are a few left.)* Those of you who were in Chem 1 expected me to come out here in some stupid outfit. Well, here I am.

(You know, they thought I was crazy when I dressed up like a horse and like a leopard. Look at the costumes on the people up here — it looks like a zoo.)

I was very impressed by Dick Feynman's talk last year. You remember — the main message was about scientific integrity. You know, you report *everything,* not just what agrees with your particular theory. You report everything, so people can evaluate all the facts and make their own judgments. You lean over backwards to be scientifically honest. Scientific integrity. That was the message last year.

The press was obviously impressed too. Because in announcing this year's commencement talk, most of the space was devoted to last year's speaker. Hell, it takes eight lines just to write "Richard P. Feynman, Richard Chace Tolman *(you remember him)* Professor of Theoretical Physics and Nobel Laureate, and he spoke last year about blah, blah, blah, and — by the way — this year's talk is by Harry Gray."

I had to retaliate! I had to one-up Feynman. How could I do it? Well, I thought briefly about getting some material from my sidekick, Murray Gell-Mann, but I know Murray too well. I know he's fallible, so I discarded that theory right away. Then it hit me — *Einstein.* There's the one guy who's smarter than Feynman. I'll get some material from Einstein.

So I went back for the third and final time to the archives and I said, "Judy, did Einstein ever speak to the student body at Caltech?"

And she said, "Sure he did, but he always spoke in German at Caltech back in the thirties."

I got a little nervous until she told me that there was, in fact, a translation of his speech. Here's part of what Einstein said:

> Why does this magnificent applied science, which saves work and makes life easier, bring us so little happiness? The simple answer is because we have not yet learned to make sensible use of it. In war, it serves that we may poison and mutilate each other. In peace, it has made our lives hurried and uncertain instead of freeing us in great measure from spiritually exhausting labor. It has made men into the slaves of machinery, who for the most part complete their monotonous long days' work with disgust, and must continually tremble for their poor rations.
>
> You will be thinking that the old man sings an ugly song. I do it, however, with a good purpose, in order to point out a consequence.
>
> It is not enough that you should understand about applied science in order that you may increase man's blessings. Concern for man himself and his fate always forms the chief interest of all technical endeavors. Concern for the great unsolved problems of the organization of labor, for the distribution of goods, in order that the creations of our minds shall be a blessing and not a curse.
>
> Never forget this in the midst of your diagrams and equations.

That was Albert Einstein on February 16, 1931, to the Caltech student body, translated by somebody and slightly retranslated by me. *(Sorry, Judy.)* Obviously, what he said over 40 years ago has relevance to our situation today.

Einstein's whole talk was not much longer than the passage I quoted. If it were printed in *Engineering and Science,* it would occupy less than a full page. In contrast, last year's talk by Dick Feynman ran four full pages in *E&S.* And if you think about that comparison for a moment, you will realize that poor old Harry Gray will have to give a talk that is

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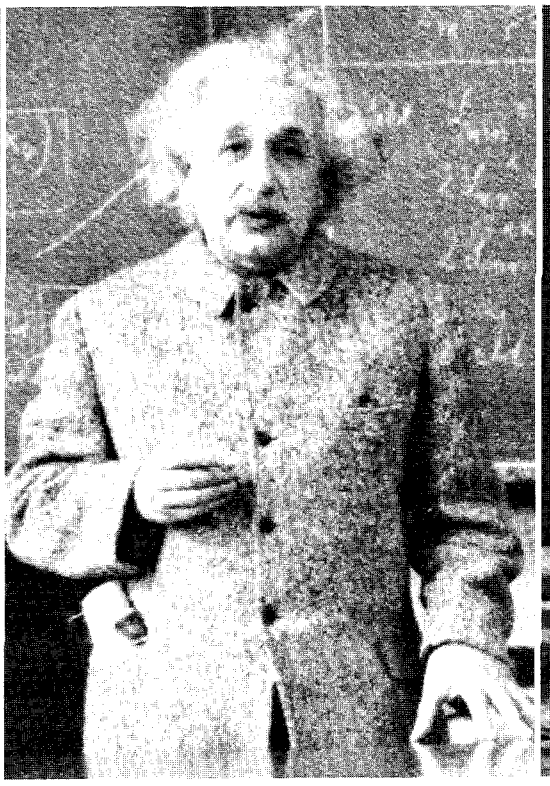
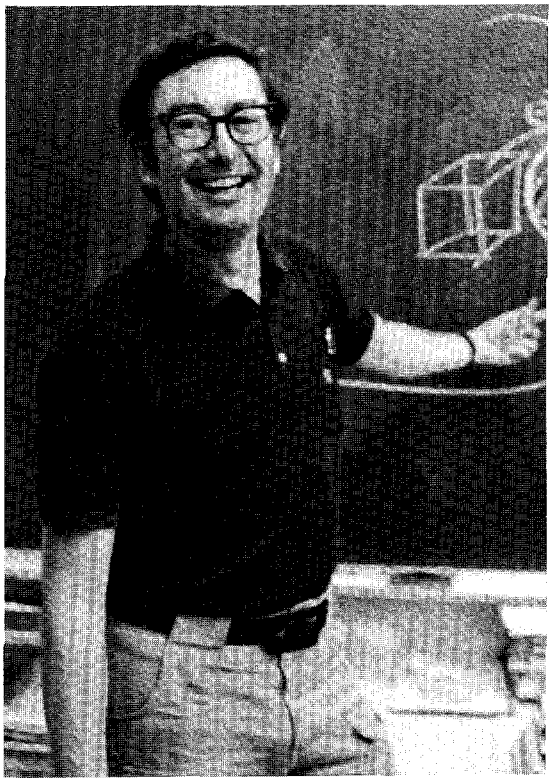
F Feynman—"Have absolute scientific integrity."



E Einstein—"Do science, but with concern for mankind."



G Gray—"If you don't love it, don't do it."

infinitely long. I'm not going to do that. I'm simply going to add just one important bit to what Feynman and Einstein have already told you.

There's plenty of challenge today. In fact, there's more challenge than there's ever been, both in pure science and in applied science. For example, everybody knows the big energy crisis is here; everybody knows we're running out of juice to run the world. This problem will not go away. We've got to do something about it. In the next 25 years we will have to find fundamentally new ways to make fuels and materials, and at the same time we have to protect the place we live — the environment. That's a *big* challenge.

There are equally large challenges in all areas of science and applied science right now. You're going to be in the middle of all this excitement, and there's going to be a lot of pressure on you in the next 25 years.

And so my advice is — to add to Feynman's and Einstein's — you'd better love what you're doing. Don't do it if you don't love it. Find a field that you can really live with all the time, that you really like. If you've found such a field, stick with it; don't let anybody talk you out of it. If you haven't found what you really want to do yet, keep searching. And when you find it, don't let anybody talk you out of it.

That's the third part of a three-part formula that I will leave you with. Feynman's part: Absolute scientific integrity. Einstein's part: Do science, but with concern for mankind. Gray's part: If you don't love it, don't do it.

In order that you can really remember the message, I hereby give you the Feynman-Einstein-Gray formula: F-E-G, FEG. The FEG formula. You can add it to your special Caltech vocabulary. You know, "trolling," "snaking," "flicking," and now I give you "fegging." You can also see why I had to use Einstein in this talk; I couldn't use my friend Archimedes, or Aristotle, or the chairman of the board — or certainly not Amedeo Avogadro.

Now's it's time for you to graduate. *(Actually, it's time for the Glee Club.)* I wish you all much success. I hope you come back to campus many times. We need you. We need you to help us keep Caltech the place where, for example, Page House can outsmart McDonald's; where a lousy Chem 1 lecturer can be dumped in Millikan Pond; and where students and faculty and staff and administrators can continue to work together closely. That's what I mean by the chemistry of Caltech. Thank you. □

Humanism and Science

by ROBERT L. SINSHEIMER

THE most common view of the relation between humanism and science is that the two elements are antithetic. In my view humanism and science are complementary. And indeed, I believe that in the last analysis each includes the other — which is not to say they are identical. But this antithetic view has a long and I suppose distinguished history dating back to virtually the very beginnings of modern science.

One need only recall Blake's famous line "May God us keep/from single vision / and Newton's sleep" through Wordsworth's "Sweet is the lore which nature brings; / Our meddling intellect / Mis-shapes the beauteous form of things:— / We murder to dissect." And on to Snow's two cultures and Roszak's critique of science as a "monster of meaninglessness" and his distinction between information and knowledge or, as he calls it, gnosis.

Humanism and science are symbolically related, but in dramatic contrast, in Paul Conrad's recent editorial cartoon.

And today, as Lewis Mumford writes in *The New Yorker* (March 10, 1975):

> I was born in October, 1895, five years before the turn of the century . . . . Being a child of my time, I expected much of the new century. This period was destined, almost everyone then confidently supposed, to produce even greater wonders than the steam engine, the electric telegraph, the Hoe printing press, the dynamo. For daring inventors and even more daring prophets, such as H. G. Wells, were already proclaiming that the airplane, the ancient dream of Flying Man, was just around the corner. And, indeed, these one-eyed prophecies came true. Things of another kind, unfortunately, were also lurking in the same dark alleys of the future . . . .
>
> Even now, perhaps a majority of our countrymen still believe that science and technics can solve all human problems. They have no suspicion that our runaway science and technics themselves may constitute the main problem the human race has to overcome.

On the other side the attitude, I fear, has frequently been less one of antagonism than one of condescension — an attitude that the humanities were perhaps pleasant diversions, but irrelevant to the real issues of enduring importance; that the humanities lack intellectual rigor and authenticity; even going so far as to say, in a quote attributed to Bronowski by Roszak, that the artistic response to nature is "a strangled, unformed and unfounded experience."

But what are the origins of these postures? I do believe that there is a significant dichotomy in the perceptions of the practitioners of the two disciplines. The humanities and the sciences both represent projections of the human mind, ways in which the human mind seeks to encompass the human experience. But they emphasize quite distinct aspects of that experience.

The humanists are concerned with the world of man and

The most common view of the relation between humanism and science is that the two elements are antithetic, but in my view they are complementary

particularly with those qualities that are *peculiarly* human — speech and language and the associated arts of literature, drama, poetry, history; with the esthetic and the artistic and the visionary; with logic and reason and with the human gift of anticipation and its corollary burden of decision and value judgments; and with those feelings that are peculiarly human — compassion, hope, wonder and awe, doubt and grief and regret, rapture and love.

On the other hand the sciences are concerned with the world of nature, and when they do consider man, they are then most interested in those aspects that link man to the rest of nature — to the world of physics and chemistry and particularly biology; that is, the sciences are concerned with man's most general qualities, not his specifically human qualities.

Oddly, the humanities have almost never included science itself as a peculiarly human achievement. It is only very recently, and as yet very seldom, that historians have become interested in the history of science, that playwrights have found drama and conflict in the lives of scientists, that philosophers have pondered the logic of scientific discovery, that aesthetes have recognized the imagination and creative artistry in the scientific ordering of human experience, that essayists have been concerned with the effects of the social milieu upon the origins and directions of science, that novelists have portrayed the human consequences of life in a technological society based upon principles incomprehensible to most men.

It is also odd that the humanists are not yet keenly alert to the insights into the origins of human qualities that are beginning to emerge from the developments in the neurosciences, that those interested in aesthetics have not yet reflected deeply on the significance of the specific modes of analysis of visual input common to primates, that the logicians have not yet reckoned with the limits to logic that may be imposed by the structures of the human brain.

Perhaps, because the humanists focus upon the peculiarly human, it is not surprising that they eschew — and even resent being reminded of — man's biological bases. They resist and find distasteful the concept that we too, like other creatures, are in very considerable part the product of our genes; that our human faculties must arise in a programmed way in the development of each individual, and that these faculties must be the consequence of an evolutionary, prehuman history.

From the beginning the humanists have deplored what they regard as the exaggerated emphasis which the practice of science confers upon one human quality — what we may call the cerebral, Newton's single vision; at the expense of other human qualities — the sensual, the aesthetic, the emotional, the visionary.

And today when science and its child, technology, have in a seemingly inexorable manner become the driving forces, the engines of our social system, the concern of the humanists has enlarged from the purely intellectual arena to spread an alarm throughout society — to challenge the course upon which science and technology have subtly led us.

They ask, "Where is science taking us?" and they warn of danger at several levels. To quote Mumford:

> Strangely the palpable rationality of the scientific method within its own accredited area gave rise in the great majority of its practitioners to a compulsive irrationality — an uncritical faith in science's God-like power to control the destinies of the human race. Those who have studied the ancient Mesopotamian and Egyptian religious texts know how cruel, destructive, and inhumane man's God-like faculties actually can be.

The humanists warn of the dehumanization of man in the technological society through the glorification of certain qualities, the cerebral and the analytical, at the expense of the emotional, the sensual, the holistic. They warn of the dehumanization of man through the estrangement of man from nature — his displacement from the natural environment in which man arose, to this technological society that seems to have its own imperatives for which man may or may not be adapted.

They warn of the hubris of wielding powers beyond human scale, of the danger not only of overt nuclear catastrophe, or of the other "white coat horrors" — the more subtle but

foreseeable possibilities of a breach of the ozone layer, or the triggering of a new ice age, or the creation and escape of a lethal virus — but also of the hidden hazards latent in the burdens that a technology may place upon a society. They warn thus of the dangers in a nuclear technology that will produce wastes that must be sequestered for 25,000 years, an "unforgiving" technology that is woefully subject to sabotage or terrorist subversion. Indeed, from this perspective one can, for perhaps the first time, conceive the specific reality of the Faustian bargain — that science could indeed wholly innocently and inadvertently lead us into a deadly trap. Suppose, for instance, it had so happened that hydrogen bombs could have been easily made in someone's garage. Fortunately this is not the case, but there was no way of foreknowing. And I see no way our social order could have contained such a consequence, once the fact was known. Could there be another such potential abyss lurking in the future?

The humanists warn, and it is most fitting that they do, of the possible consequences of scientific intervention in man himself. What may be the effects upon the *peculiar* qualities of man of behavior modification, or more ultimately, of human genetic engineering?

The humanists thus challenge many of the trends of our time, and they place the responsibility for these dangerous courses upon a runaway science and technology, heedless of human values, deaf to the voices of despair.

And what of science now in our time? What response do the scientists make to these charges? Where does the scientist stand with respect to the human and social consequences of his work? The traditional posture of science has been that of a lofty reverence for knowledge for its own sake, with the implicit assumption that knowledge is preferable to ignorance and with the faith that the net consequences will be beneficial. For most scientists, that is still the shield they raise. This posture may have flexed to some small degree, not so much with respect to science per se as with respect to technology, the application of science. Even this slight bend is grudging — in part, a consequence of self-discovery; in part, of persuasion; in part, perhaps, even of compulsion.

By compulsion I mean simply that science has become expensive. The sophisticated experiments of today require complex instrumentation and money. And the scientist has been compelled to recognize that society must be persuaded, for one motive or another, that the support of science is worthwhile or else science will cease.

By persuasion I simply mean that intellectually the alarms of the humanists cannot wholly be ignored; there are indeed *elements of such cogency that the scientist cannot blithely* dismiss them.

Most important, because most convincing, is the change in some degree in the self-image of the scientist himself — in his self-discovery.

In part, it is a simple consequence of the fact that he too must live in the society his discoveries have helped to shape. In fact, of course, he is far better equipped than most to live in this society, for he understands more of the underlying principles of technology. But he too must endure pollution, he too must share the fear of sudden annihilation, his children too must cope with alienation and all the moral confusion engendered by swift change.

Too, as Oppenheimer said after Alamagordo, "The scientist now knows sin." That innocent faith that the net consequence of science is always beneficial has been breached.

And, even more profound, there is, in some quarters, a growing recognition that by the means of science the balance between man and nature has perceptibly shifted, so that once innocent human ideals boldly proclaimed in the age of human impotence are now seen to be less noble when, even partially, the ideal becomes reality.

This is a curious and sobering twist.

Even Francis Bacon would surely have wondered at this turn of events, though he saw most clearly the potential latent in science, the power inherent in what we would today call the disciplined imagination, trained to look back as well as forward, to test its vision again and again against established knowledge and designed experiment. Three and a half centuries ago, Bacon wrote:

> The roads to human power and human knowledge lie close together and are nearly the same . . . Now the empire of man over things depends wholly on the arts and sciences for we cannot command nature except by obeying her.

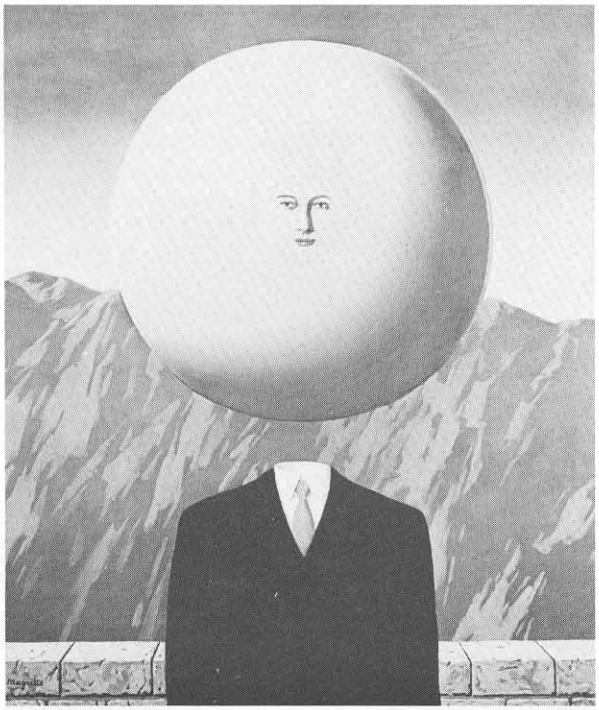
As an aside, there is an interesting, implicit assumption in this statement. For Bacon it was clearly man's prerogative to "command" nature; he sought only the means. In this, of course, he was but an heir to the Western tradition upon which, in fact, he sought only to improve. A more passive life style — a life of coexistence within nature, as in the Taoist or Navajo tradition — would have been wholly foreign to him.

In Bacon's time man's power "over things" was so cruelly limited. Afflicted with plague, cursed by want, choked with superstition, men must have felt that any increment of knowledge, any enlargement of human control over human destiny, seemed desirable — a change for the better. And Bacon foresaw science as the means to enlarge human knowledge and human power. In fairness, though, one must point out that the Baconian vision of the power of science, while wholly correct in principle, was far too limited in scale. He could, of course, hardly have conceived of hydrogen weapons or genetic engineering.

Today, three and a half centuries later, we have achieved a deep understanding of, and very considerable control over, the natural universe. We have learned to command nature by obeying her. And today we are also learning that with command comes responsibility and the necessity for choice. And the necessity for choice brings science abruptly to those issues with which the humanists have always been concerned — the definition and ordering of values.

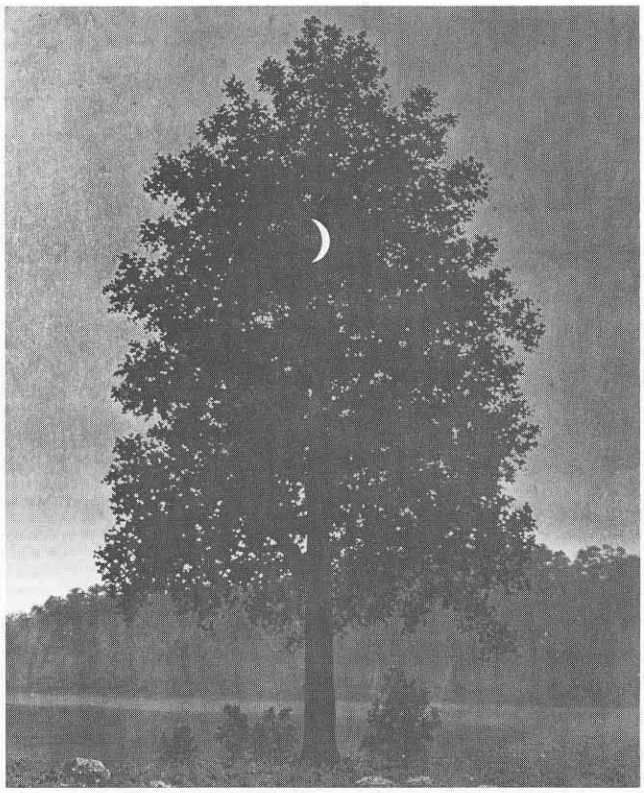
continued on page 26

"No scientist, only an artist, could produce fantasies that delight us by the rearrangement of the real world."



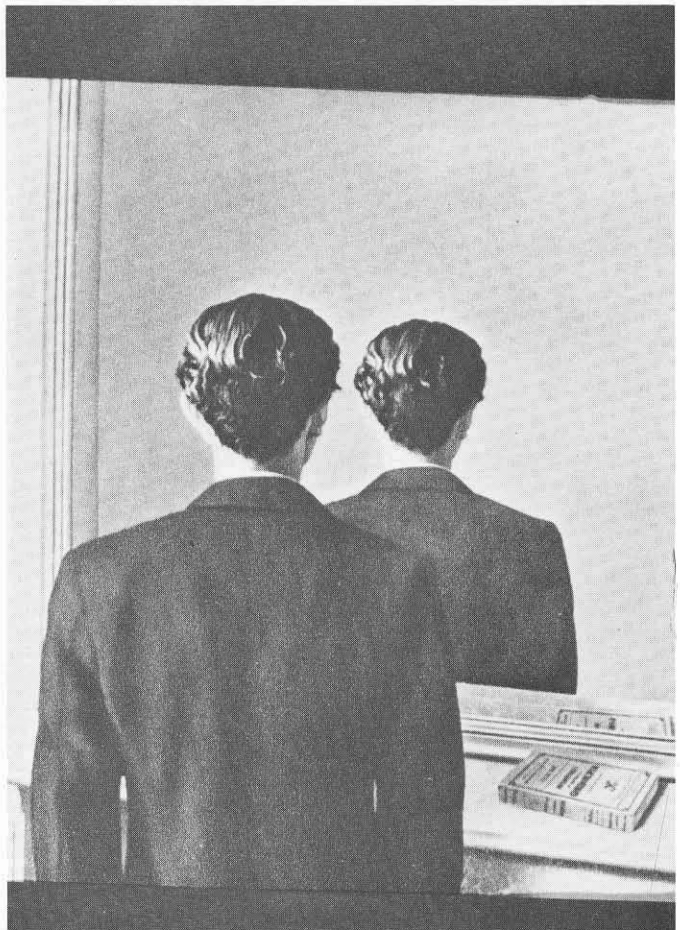
Rene Magritte—"The Art of Living"

Magritte—"September 16"



Magritte—"Signature in Blank"

Magritte—"Not to be Reproduced"



The Apollo-Saturn—ready and waiting.

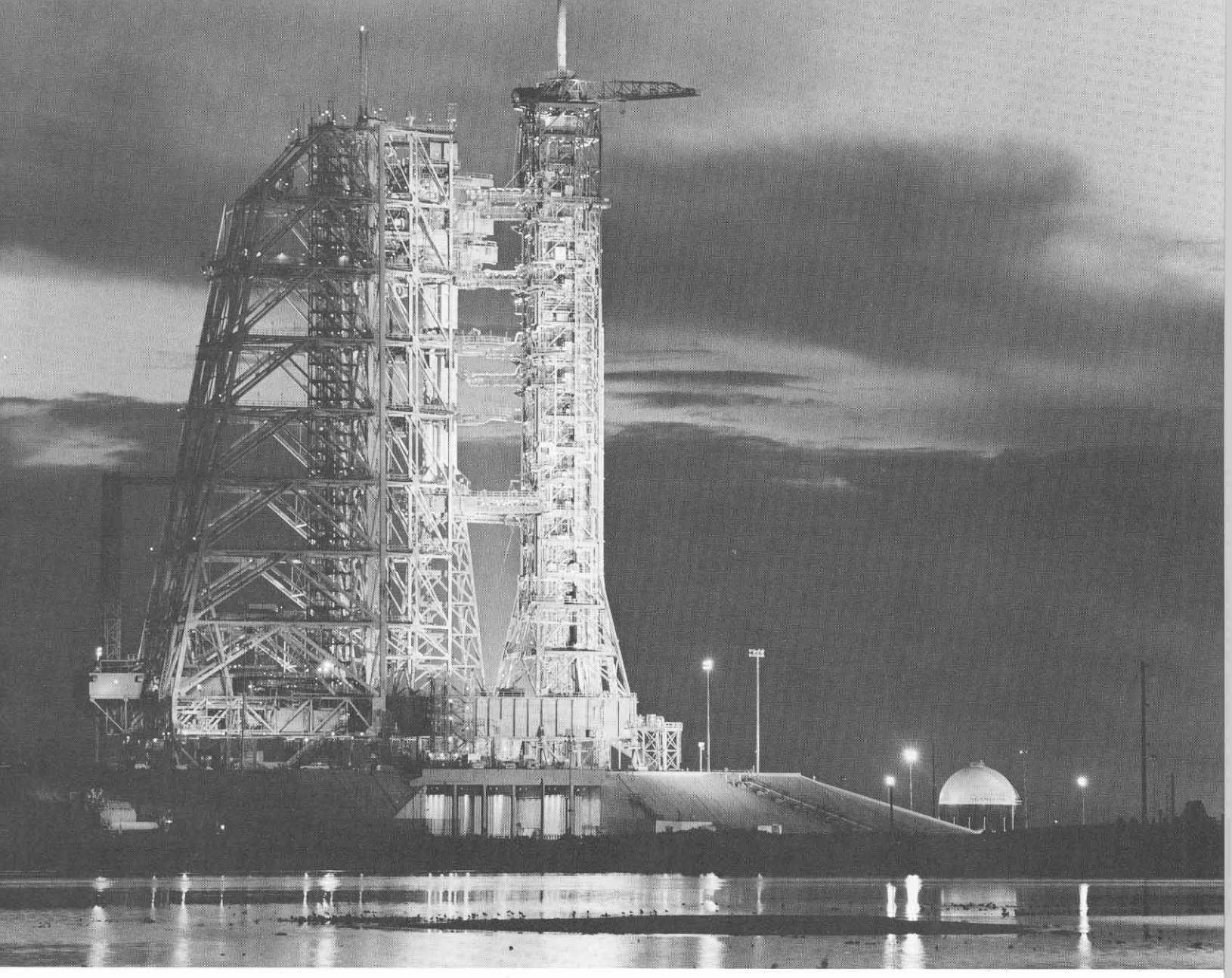
Thoughts at Liftoff

by POUL ANDERSON

A noted science fiction writer reports for E&S on the launch of the last Apollo

SHE had not all the terrible beauty of her moonship forerunners; but when the Saturn IB blazed aloft, trailed by thunder, bearing her Apollo to rendezvous off Earth with Soyuz, there were tears in more eyes than mine.

Every launch has been unique, wholly unforgettable in its particular ways. Even those parts which, like love, have been written about in untold millions of mostly banal words — such as the sheer size of things — must, like love, be directly lived to be understood, and are never twice the same. It was always a fresh marvel how the Vehicle Assembly Building has no scale in the flat Florida landscape as you approach across miles, how the immensity does not yet register as you stand below the main entrance, but a dread of heights may awaken when you go inside and look up. The crawler which brought the rockets from there to the launching pads remained impressive enough in its own hugeness, though with a hint of comedy about it, like a hippopotamus (which, after all, was the Biblical Behemoth). As for the Saturns them-



The Apollo-Saturn, shot at sunset, before the Mobile Service Structure rollback.

selves, their magnitude soon became secondary, in the face of so much loveliness.

We visitors always got a specially sharp sense of how exquisite they were when we stretched our press privileges and sought the right vantage point on nights before a liftoff. Then searchbeams limning the ship silver on black would stream back in haloes and tails, far across heaven, as if this were a comet already outward bound. The supreme experience, akin to seeing the Winged Victory or hearing the last movement of Beethoven's Ninth, was when she rose, fire, shout, and triumph. This likewise was forever new. Time of day, weather, each circumstance created something unrepeatable. It is right that the last Lunar mission to ride a Saturn V went in a glory made double by suspense beforehand and darkness around.

Other joys have been plentiful, too — delight in virtuosity, in the fact that nature in the form of our largest bird sanctuary surrounds the whole space center, in belief that here humanity is accomplishing something altogether worth doing. They will abide. But the world will not likely ever again witness a sight as splendid as those which have now come to an end.

That is as it should be, a kind of maturing. We can't afford very many inefficient marvels. Man will only get into space to stay by cheaper, less spectacular means, of which the shuttle is the harbinger; and that will mean turning adventure into commonplace, as has happened with aviation. Still, we don't forget our youth. Aren't its visions what keep us going for the rest of our lives?

This is my reason for bringing aesthetic, spiritual questions into a publication oriented toward technology. Man does things, including engineering and science, because he wants to do them. Economics and politics are not his sole motivations, nor are they any more rational than a wish for the purely passionate. In an era of swelling technophobia, the technologist is wise to bear in mind how much more he has to offer than kitchenware and bombs.

Watching the rocket go up, I thought — no, not really, because you don't think at such times, you simply are — afterward, I thought that the fakiness in this mission didn't matter. Let me explain that at once. They were fine, brave, dedicated men aboard both Apollo and Soyuz. The scientific experiments were legitimate and valuable. But the public relations side on which world attention focused, the joining, the cooperation, was as meaningless as the rest of "détente."

Rescue capability? Here was the last Apollo. Our next manned flights will be with the shuttle, several years hence; and it, if a Soyuz is then in trouble, can lay alongside and take the whole capsule into its cargo bay.

Exchange of information? We know how reciprocal that was.

Symbol of a happier era among nations? Well, never mind. Let's just say that some of us remember many and many a gesture of the same sort during the past half century, and what came of them.

Regardless, at launch time, at linkup, at the safe returns which we all heartily wished both crews, the bunkum didn't seem important. It hadn't seemed so either when it consisted of Madison Avenue flackery about "spinoff," as if sending men to the moon were a reasonable way to develop new plastics. Athens financed the Parthenon with money embezzled from the Delian League; sordid quarrels went on while Michelangelo was painting the Sistine Chapel. What got done is what still touches our lives.

The knowledge that human beings were outbound lay deep within the feeling about a mission, among that coterie of science fiction people who for years had been getting together for these occasions. But surely it did also in the hordes who came to watch, not in the comfort and nearness of a press grandstand, but from afar, oftenest beneath an unmerciful subtropical sun. Why else would they?

And what's wrong with romance and beauty? Don't we the public buy ourselves plenty of both? Wanting them, needing them, we maintain city parks, art museums, orchestras, historic sites, scenic regions, wilderness preserves. Space exploration has likewise given them to us.

True, a great deal there has come from unmanned craft, in the form of soul-catching unexpected visions of the universe. So too has a great deal of the workaday benefit, such as a revolution in meteorology which I claim has already returned a profit on the entire program. But manned expeditions have made their own contributions. Furthermore, perhaps most vital in the long run, they have bestowed a glamor without which the whole enterprise could never have gained the support it did. Men and women will be needed in the future to keep its momentum, as well as for practical tasks.

This came rather poignantly home to my wife and me when we went upstairs in the NASA center for journalists, to a room maintained by the group preparing for the Viking flight to Mars. The attendants looked so lonely, they were so pleased when anyone dropped in for a bare minute. And yet what they had to tell, and the exhibits around them, were fascinating. Whether or not it finds signs of life, Viking will be immensely more significant than Apollo-Soyuz, fully comparable to robot Lunar landings, quite possibly more revelatory than any probe before it. Nevertheless, that room had few guests. And as I write, the survival of projected Pioneer Venus is uncertain, despite the numerous clues to Earth's own atmospherics, fluorocarbon chemistry among them, which earlier sendings have found.

At the NASA facility at Ames, California, where we had been not long before, we heard about quite a few crises in the course of unmanned missions. The resourcefulness with which the staff met these challenges is in itself a great wonder, and the human circumstances were apt to be as dramatic, in a quietly tense fashion, as any lover of good stories could wish. However, little of it ever reached the world at large. What captured the news media and the public was danger to human life in Apollo 13, or human hands actually on the spot rescuing Skylab.

To this, some of the people at Ames would no doubt reply tartly that had they been in charge, neither the peril nor the necessity for elaborate repair operations would have arisen. They'd not have designed vehicles involving live crews in the first place. That philosophy is worth a close and respectful look.

In Earth satellites, Rangers, Mariners, Pioneers, not to mention numerous foreign vehicles, from Mercury to Jupiter and now beyond, it has paid off brilliantly. The knowledge gained won't be fully evaluated and understood for years; and by then, much more will have come in. The engineers have magnificent things on their drawing boards.

For instance, there is a Mars orbiter which will fire probes *into* that planet, to examine conditions below the surface; instruments will survive forces in the millions of gravities. There is a Jupiter orbiter which will not "merely" send a lesser vessel down into atmosphere; by judicious jet nudges, it will make the moons Ganymede and Callisto swing it through petal-shaped paths into distant regions, to study the high latitudes and the further parts of the magnetosphere. There is a pair of craft, launched toward Jupiter by space shuttle, which the Jovian world will throw out of the ecliptic plane, north and south, and back toward the sun, to give us our first real view of its poles. There are missions to the outer members of the Solar System, to asteroids and comets. There is Pioneer 11's present course for Saturn, whose moon Titan just may hold life and certainly holds something strange. And nobody can guess how much remains to be done nearer home, in Earth orbit or by crawlers on Luna.

Undeniably, for a long time to come, perhaps always, the large majority of our quests into space must be carried out by machines. Besides doing many jobs which men could, at far less cost and hazard, they can do many others which are impossible for men.

And still . . . that Ames philosophy also turns on the idea of the "dumb" spacecraft, closely controlled from the ground — humans an integral part of the whole. Besides saving the expense and development time of elaborate automation, it gives flexibility and quick response to an unforeseen problem

or opportunity. People are in charge of each of these vehicles throughout its service life. None can be called unmanned.

Moreover, we have had failures, several of them grievous, which a man could have retrieved had he been present. One purpose of the shuttle is to get technicians up, quickly and cheaply, to do precisely such work. Soon they will also find themselves making original assemblies in the void, more handily than machines could. Later they will become the logical agents of detailed explorations, follow-ups to necessarily limited investigations by crewless craft. And a number of them will find they like it out there.

Ames itself played host (without any actual endorsement) to a ten-week conference in the summer of 1975, on the O'Neill proposal to establish self-supporting colonies at the stable Trojan points of the moon's path. Given that capability — which physicist Gerard O'Neill of Princeton calculates we have today — then, if we exercise it, we will certainly continue into deeper space. For as Robert Heinlein has remarked, considering the energetics involved, once you're in Earth orbit, you're halfway to anywhere.

Notice again how O'Neill's ideas have caught the general imagination at a time when more sober-looking projects are being undeservedly ignored, starved, or strangled. We do not live by equations alone. It is a terrible mistake to leave out of our plans the fact that a big rocket rising is beautiful, doubly so when the payload is human.

The immediate, urgent, realistic reason to continue our space endeavor is the knowledge to be won: in physics, chemistry, planetology, biology, every science. Three centuries of history since Galileo show what impact that will have on mankind as a whole. The expenditure of resources is negligible compared to what we throw away on international strife, domestic crime, avoidable inefficiencies, or simply booze and cigarettes. It is infinitesimal compared to the gains to be made. Another science fiction writer, Hal Clement, has observed that when people are adrift in a lifeboat, they don't share out every bit of food; some they chop up for fishbait.

The reason to give flesh and blood a direct share in the enterprise is equally practical. Man, or woman, is the only instrument that can perceive or do what it is not specifically designed to perceive or do, the only computer that continuously reprograms itself, the only thing that gives a damn. But overriding this is the likelihood that nothing except a continued human presence in space will keep alive indefinitely a human interest in it. We work that way.

Whether or not many of us will ever be out yonder is, today, moot. So is the question of whether any of us will ever reach the stars. Some say not or, like Bernard Oliver, think that at best we can do it in spirit, by communication with extraterrestrial intelligences. Others, like R. W. Bussard, think travel beyond the Solar System may someday be possible, if we want it enough. I like to think he's right, and to envy our descendants. But *we* saw the beginning. Whatever we do, let's not make it the end. □

Floodlights from the launch complex fan out across the night sky.

Inflation -

A Monetary or a Fiscal Problem?

by GILBERT W. FITZHUGH

TO a non-economist businessman who likes to think of himself as a realist, the debate on this question is becoming tiresome — and is really beside the point. For once, the answer is basically simple: "Both — and more besides."

Another catch phrase is the alleged trade-off between inflation and unemployment. Here again, the basic answer is also simple: "There *is* no trade-off." In the long run, we must have *both* a stable currency *and* high employment, or we'll have neither. And in the short run, there is also no trade-off in actual operation. In fact, to assume that there is one can easily produce results directly opposite from well-meaning intentions. Fancy charts purporting to demonstrate some inverse correlation between inflation and unemployment are just that — fancy charts, which are substantially dependent on how one chooses base periods.

Wouldn't it keep us closer on target if we would just keep forever etched in our minds the incontestable facts that the unemployment of the thirties *followed* the inflation generated by World War I and the rampant private speculation and other excesses of the late twenties, and that the current unemployment *followed* the inflation caused by the government-generated excesses of the late sixties and early seventies? To argue otherwise is like saying that wet pavements cause rain. If we do keep these facts in mind, perhaps we can reduce the looming havoc of further inflation and subsequent bust.

Therefore, let's review the bidding and see how we got where we are today.

The United States economy is in a bind today that has no parallel in our previous history. The financial problems of World War I proved relatively manageable in retrospect — we fought the war and eventually paid the financial cost through means which unfortunately included climbing a few rungs up the inflation ladder. In the early 1930s we paid the piper for this inflation and the subsequent credit binge of the 1920s. The house of cards eventually collapsed, as it always does. The Great Depression was a pretty hard way to regain our senses and work our way out of past excesses. Nowadays, we seem to be trying to prove the observation that those who don't study history must relive its mistakes.

World War II was fought and eventually paid for by another leg up on the inflation ladder, and so, too, the Korean conflict. In spite of the devastation that prevailed through all these troubled periods in our history, there always seemed to be some way out.

One might say that we were just unlucky after the Vietnam conflict — an action financed almost entirely by inflation and propped up by the slogan of "guns and butter." Before we had a chance to pull ourselves together, we were hit from all directions. Boom conditions throughout the industrialized world raised demand here and abroad, and, in addition, poor crops in some countries raised the demand-supply ratio so high that our domestic food prices exploded in 1973. Supplies of other raw materials also proved unequal to demand, and imbalances in the international monetary system resulted in two dollar devaluations, which aggravated our own inflation problem.

The crowning blow was, of course, the skyrocketing crude oil prices that followed the embargo, which was in itself a totally new experience for the 20th-century United States. I would not venture to guess why Providence saw fit to cap this scenario with heavy rains in the spring of 1974, a drought throughout the summer, and an early frost — which all combined to destroy the hopes for relief from food price inflation. In any event, we faced 1975 in the economic doldrums, with high unemployment, a high rate of inflation, a housing industry in deep recession, and tremendous capital needs with seriously insufficient saving and investment in sight.

But it was not all just bad luck — it was mostly bad management. In the early part of the period, we deluded ourselves that a "little" inflation is a good way to stimulate the economy. No one listened when a few people warned that a little inflation is like being a little bit pregnant. It tends to become a lot of inflation, and sometimes very quickly. The result is inevitable, and should have surprised no one.

The common thread running through all these successions of boom and bust was an almost continual run of expenditures exceeding income — either public or private or both, and occurring in both "good times" and "bad times." In

E&S readers had plenty to say to us about Professor Alan Sweezy's article on "Keynesian Economics and Inflation," which appeared in our February-March 1975 issue, but it remained for trustee Gilbert Fitzhugh, in responding to Dr. Sweezy's remarks, to produce a full-fledged article of his own - which we present herewith.

simple language, we were (and are) living beyond our means. Theories to the contrary notwithstanding, "now" never seems to be the time to pay off a debt — better mañana.

The monetarists are correct in theory. You can't have inflation without an increased supply of money. But if large deficits are incurred, especially by the Federal Government, the only alternative to increasing the money supply is public or private bankruptcy — or both.

To blame inflation solely on the increase in the money supply is to wear blinders to blot out the fiscal mismanagement that leads to a monetary "bailing out" operation through the printing press.

It would be helpful if our decision-makers learned early that inflation is neither inevitable nor desirable, but that it is intolerable, wrong, unhealthy, and immoral, and simply must not be permitted to continue.

Those who have called it stealing are not exaggerating. Some have said it helps borrowers because it makes it easier to repay loans. How many borrowers would really want someone to lend them $100 and then one year later pay back $90 principal and, say, $7 or $8 interest? Would they think it was fair for the lender not even to get his bait back? (And would they ever expect the lender to lend them money again?) Would they understand the injustice any better if the lender had loaned them 100 bales of hay instead of 100 dollars? Either way, the effect is the same as if someone put his hand in everyone's pocket and took out $10. Is it surprising that inflation leads directly to higher interest rates — particularly when the government considers the $7 or $8 interest as income and taxes it, but does not recognize the $10 drop in principal as a tax loss?

It would also be helpful beyond measure if our decision-makers learned that increasing productivity is not an economists's whimsy, or a devious way in which an employer can extract blood, sweat, and tears from his work force, but rather is the only means of improving and spreading both the high standard and the quality of living enjoyed in the United States.

Unfortunately, instead of bending every effort to control inflation and increase productivity, successive governments, in attempts to ward off the inevitable day of reckoning, pulled one rabbit after another out of the hat. *Anything* rather than face the unpopular truth that we were living beyond our means. Our leaders kept telling us that various palliatives were needed to "buy time" to cure the root causes. Try to recall all the temporary and often detrimental measures adopted under the guise of "buying time" in order to get at the fundamental causes of our balance of payments problems. Was anything constructive done with the time so bought? The sorry routine in dealing with that and other problems was to sit back and wait for the next crisis, and then pull another rabbit out of the hat. It may be true that it is hard to get this country to act without a crisis, but we're running out of rabbits. To use my actuarial jargon, we used up our contingency reserve, and when the going got real tough we had no cushion left.

Certainly, inflation is not confined to the United States. It's a worldwide disease, and each country compounds the problems of the others. However, it is no comfort in looking at United States price rises to say that the situation is worse in some other countries. With this country's vast natural resources, huge market, industrial development, and productive workers, we *should* have the best record of price stability. We like to consider ourselves a leader. Let's be a leader in the battle to protect the value of the dollar. Remember the expression "Sound as a dollar"?

There is no doubt that we will get through these trying times — the point is, how, and when? It might even turn out that the present situation is such that we find ourselves with no alternative but to return to the use of common sense — that most uncommon virtue — hopefully before we are forced through another economic wringer. Perhaps we're ready to rid ourselves of some of the nonsense that has been allowed to gain so much headway, and begin again to rely on hard work, integrity, and thrift — in other words, that old-time religion brought up to date, despite the ridicule often heaped upon it, even from those who should know better.

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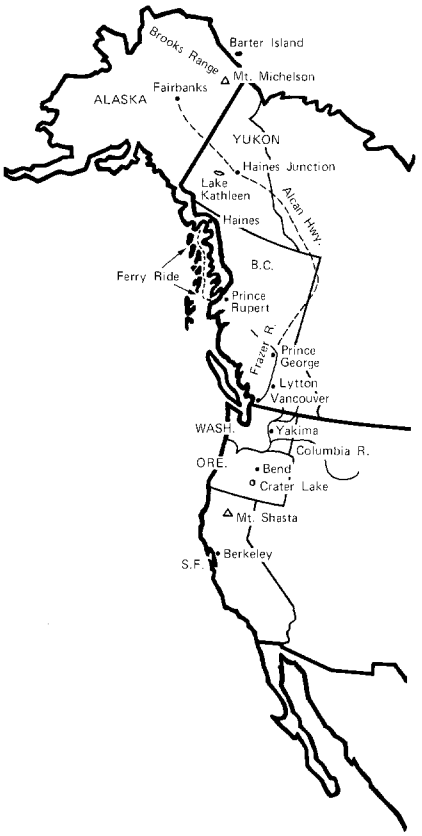


On Motorcycling

A 6,000-mile ride from California to Alaska and back proves that motorcycles are the only way to go

by JOHN D. PETTIGREW

WE had always regarded motorcycles with a mixture of scorn, cynicism, and awe. Amongst our circle of mountaineering friends the subject of motorcycles always aroused laughter, and despite the memorable words of Brian, an incorrigible cyclist (''You miss it all in a car.''), most of us were happy to miss out on the experiences he had enjoyed, like his collision with a kangaroo and his manhandling of the bike over ice-covered roads.

However, Rona and I now know that motorcycles are the only way to go. On a mad impulse one summer we bought a couple of Honda 350's and rode them the 6,000-odd miles from California to Alaska and back.

Day 1

Berkeley, California, to Crater Lake, Oregon

We rise before dawn with the idea of avoiding some of the freeway traffic, but it is 7 o'clock before we manage to attach the huge mountain of food and gear onto the poor Hondas. We have heard that food is very expensive in Alaska, so we take 80 pounds of our favorite delicacies with us. Crowned with crampons, each mass looks pretty formidable at 65 mph when we eventually get onto the freeway north. Motorists are fascinated and truckies surprisingly friendly, especially when they get close enough to see the long hair and pretty face under Rona's helmet.

From the beginning it is a complete sensory trip. All sensations are present in a broader and more unusual way, but the biggest treat of all is for our noses; we actually smell our way across thousands of miles of varying countryside.

The first few hundred miles are through the rich vegetable bowl of California, the central valley of San Joaquin. Here the hot, dusty, pollen-laden air from the grain fields contrasts alternately with the cool, verdant smell of the clover and alfalfa fields where there are sprinklers for air-conditioning.

In the afternoon we are into the cooler, forested foothills of the great volcanoes of the Pacific Northwest. The bikes, playing up a bit in the extreme heat of the valley, love the cooler mountain air and fly faultlessly along the steepening, windy, winding road. The resinous scent of cedar and pine hangs coolly in corridors cut through the conifer forests, while in the open the sun coaxes many unidentifiable perfumes from the fields and bushes of wildflowers. In these open patches we have views of Mt. Shasta, the southernmost of the great volcanic chain.

Near the Oregon border a wet, humuslike scent announces a swamp, and we find ourselves flying side by side with the brilliant blackbirds which nest there. One species is a gleaming black and yellow while the other has vivid red epaulettes as well.

In Oregon the farmers are making good use of the volcanic soil, and there are myriad vegetable smells interspersed with the smells of death — rotting prairie dogs (victims of passing cars) — and the pervading burnt sawdust belched from the wigwams attached to the many timber mills of this heavily forested region. At our first ''gas up'' in Oregon we notice an easy-going attitude on the part of the service station manager-and-wife, unlike the typically hustling garage attendants further south. This trend continues as we get further north into less populated regions and among the free-and-easy Canadians, who are most like the ''mad hill tribes'' of our Australian acquaintances back home.

We camp in dense conifers 400 miles from our morning's start, and after a mutual massage of the tired muscles that bikies must know so well are soon asleep.

Day 2

Crater Lake to Yakima, Washington

Another 400 miles — which begins with a pleasant side excursion to spectacular Crater Lake. The road winds through 30-foot banks of snow and emerges on the rim of a

deep, water-filled crater about four miles across. An exhilarating flight around the snow-covered rim leads to a steady descent through forest to Bend, Oregon, and our first oil change. At the bike shop we meet many kindred spirits and chat about the great touring life while we do the change. Hondas get a unanimous vote for reliability, but there is some argument about whether they should be "chopped" or not. I am surprised to find that "choppers" are built more for comfort than for style. Chopping and extending the front forks and the addition of footbars allow one to sit back out of the wind in a comfortable easy-chair position. While our big loads make comfortable backrests, it would be nice to be a little lower out of the wind, and we decide we should ride a chopper just to see how much more unsteady it is made by the extended front fork. For the time being, the only custom modification we make is to add new vaned grips to the handlebars. On the previous day our right arms had become very sore from holding the vibrating small-diameter grip at ¾ throttle all day.

The afternoon is hot and gusty, and we cross the vast plains of lava, interrupted occasionally by abrupt gorges with columnar sides. The last of these, that of the Columbia, marks the Washington border, and darkness finds us winding up the gorge of one of its tributaries, looking for a place to stop. The absence of most of the visual cues makes the drive an unearthly and scary float, with only a bright patch of road ahead as the reference point. It is a great relief to get off the road and down to the river for a swim and camp.

Day 3

Yakima to Vancouver, British Columbia

This is an easy 300 miles, heading west toward Seattle and across the Canadian border. The pass across the Cascade Range is quite high, with scattered snowcaps about it, and we put on our windproofs for the first time in the cold, damp air being blown up from the Pacific Coast. The descent to Seattle introduces us to the dark forests of Sitka spruce, which we would see all the way to Alaska whenever we were on the coast. On the green shores of Puget Sound, Rona points out an otter skipping from one waterway to another. Canada reminds us of home, but we could do without the mad Sydney-like traffic of Vancouver, which we strike at peak hour.

The memorable smell of the Pacific Northwest is the aroma of overcooked cabbage that is belched from the pulp mills.

Day 4

Vancouver to Lytton, B.C.

Scorching heat. Have to use chain lube every 100 miles. Frequent stops for swims and to cool off poor laboring bikes. Scenery wild, uncompromising gorges (Fraser River). We find we're the only comfortable travelers (except for truckies in refrigerated semis). We meet two young Adonises on 10-speeds bicycling across Canada. Very effective warnings carried by them: 10-foot fiberglass fishing rods tied to back of bike with day-glo orange flap on top. We can see them easily half a mile away. These fellows are making 100 miles a day. They reckon on better than 200 miles a day across the plains with a tail wind. (Makes us feel slightly decadent with our motors.)

Day 5

Lytton to Prince George, B.C.

Another day for shorts and open-neck shirts. Bikes getting out of tune and missing a lot. Arrive in town for oil change to find drain plugs stuck. Can't budge them with our own spanners (too short for leverage) — so try to borrow one in town, with no luck at all. Honda shop is closed (Sunday), and all service stations carry only British (inches) spanners, while we need a 19-mm metric one. In desperation I try everything and only succeed in burring the nut. Profuse sweat and swearing. Forced to stay overnight to wait for Honda shop to open.

Day 6

Prince George to Prince Rupert, B.C.

Bike shop closed! Luckily manage to rouse someone by phone. Oil change accomplished as well as a complete tune-up. Rona's bike now running perfectly, mine so-so. We practice the tuning on my bike first and so do a better second job on Rona's. We're sufficiently skilled to do it ourselves next time (which will be soon, since the bikes seem to get out of tune every 1,000 miles, the way we ride them.) Buy myself a long 19-mm spanner.

Very late afternoon start, but have a magnificent ride westward into the sun through fields of flowers (daisies, lupines, and buttercups) and green forest, and beside lakes, with the mountains getting steeper and more snowy the further west we get. We're still getting thrills at every new turn in the road. We drive until dark — about 200 miles. Weather still scorching — wearing practically nothing but helmet and faceshield at 50-60 mph.

Days 7 and 8

Prince Rupert to Haines, Alaska; Haines to Lake Kathleen, Yukon

A 30-hour ferry ride through a spectacular section of the Inside Passage saves us from 800 miles of nasty gravel road. We drive past scores of waiting cars and giant campers, all "on standby" at the dock — no trouble in booking without notice on such a

popular cruise if one has a bike, which can be squeezed in anywhere on the car deck. Luxuriating on the sundeck after a 25-cent shower and a beaut seafood meal from the restaurant, we take in the mighty peaks looming out of the water. These same peaks feed glaciers which reach the sea, and one ice field (the Mendenhall near Juneau) is actually producing baby icebergs as we pass.

Once off the ferry at Haines we have 40 miles of exquisite riding on paved road through forest, beside a vigorous river, with the wild snowcaps of the Chilkat Range as a backdrop. Then the gravel road begins abruptly at the Alaskan-Canadian border. At this point, the gravel is hard packed, and we take advantage of the long daylight to put as much of it behind us as possible. At 11 p.m. we are still pushing on into the strange light of the sunset to the north. All around us is the eerie taiga or boreal forest — tiny stunted hemlock and spruce, like poor excuses for Christmas trees, golden ground cover, milky blue tarns, distant snow caps. Rabbits everywhere on the road with great, ungainly feet — apparently an advantage on the snow in winter, when their coats turn white to match.

Day 9

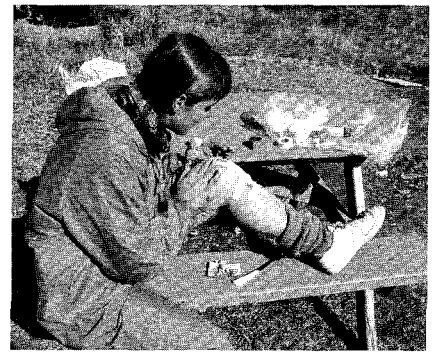
Lake Kathleen to the Alaskan border

Retrieve our food from the rucksack hanging high in an aspen, where we had strung it the night before to foil the camp bear. We had been warned of the bear by two other motorcycle tourers on Harley-Davidsons, whose deep-throated revving had been used to scare the offending animal at 3 a.m.

Set off on the least enjoyable day of the whole trip, the principal enemies being dust, semis, and road construction crews. The Canadians maintain what they call the "best gravel highway in the world," steadfastly refusing to accept the American offer to pave the horror because it might mean an end to the bountiful road taxes earned from the armies of trucks moving to and from Alaska. The maintenance involved is a constant replacement of piles of loose gravel to the center of the road. From here it is quickly redistributed by the wheels of the cargo-laden behemoths and accumulates in loose ridges on the edges — a nasty trap for the unsuspecting cyclist.

For the thousandth time I bend my head and grit my teeth. The huge cone of dust spearheaded by a relentless semi bears on past. My paranoia has increased after being battered with rocks so many times that I could swear that not only did it not slow down, but it had actually accelerated past me.

I stop on the sward and look into the receding cloud of dust for the red and white figure of Rona to appear. Two minutes pass. What the hell has happened to her? After another two minutes I break under the tension. Go, Jacko! Almighty skid around, watch that pile of rocks, painful sigh, acrid dust, thrashing through the gears, fishtail



around the first bend, no sight of her, 60 in the gravel — you're crazy, Jack.

She must have had trouble in the loose rocks near the lake edge — or could it have been that bloody semi? Horror!

An old man struggling to upright her bike in a pile of gravel on the next bend. Skid up, struggle with helmet so I can hear — his mouth opening and closing and his face is trying to tell me something. Can't get my helmet off. Her bike's lights and muffler are smashed up. Panic. "What have you done with her?" He leads me around behind his parked van. Oh, God!

Rona sits calmly applying antiseptic through the great rent in her pants to the graze on her knee. She gives me a wan but reassuring smile, and I turn to set about replacing the broken gear and clutch levers and straighten out the tailpiece on her bike.

*****

We eventually made it to Fairbanks and did a mighty trip on foot in the far north among the Dall sheep and caribou of Brooks Range tundra. That's another story.

In conclusion, let me say a little about the emotional trip which capped things off on the 3,000-mile ride back to California again.

Because we were fairly new to motorcycles at the start of the trip, we hardly trusted ourselves or each other to ride side by side down the highway. I was usually in front, sometimes irritated when Rona lagged, and she was sometimes unhappy when I appeared not to want to go at her speed. We often lost one another on the freeways of the large cities, and the combination of my aggressive riding through the mess and Rona's sane defensiveness meant the gap often lengthened until we were on the open road again.

On the way home we decided to ride side by side. At 65 mph this required complete trust and knowledge of the other's riding and gave a wonderful reward — a glowing feeling of solidarity. Our two bright headlamps, on at all times so we would be easily seen, presented an unequivocal signal to oncoming traffic to keep out of our lane. We could sense one another's joy and exhilaration with a quick sidelong glance, and communication added immeasurably to the already present fulfillment of the ride. I would indicate the red hawk swooping on a mouse in a field that she might otherwise have missed, while a mile further on she would point out an interesting side road we could take for fun. Isn't that cloud a beauty? Yes, and look at the sun shining off the water down there. All of that and your love by your side, an ever changing fragrance in your nostrils, a zooming panoramic view, a 60-mph cool whistle in your clothes, and a 6,000-rpm tickle in your ass. □

Paul C. Eaton

An Appreciation

by ROBERT HUTTENBACK
Chairman of the Division of Humanities and Social Sciences

PAUL Eaton, who died in Kennebunkport, Maine, on the 17th of September, aged 69, came to Caltech from MIT in 1946 as a visiting lecturer in English and the following year was promoted to associate professor of English and associate dean of students. In 1953 he became dean of students, a post he held until 1969. Dean Eaton was married to the noted actress Katherine Emery Eaton, and his two children, Rebecca and Jay, attended Polytechnic School.

These are the cold facts of the case. They do not tell you much about the man — that he was a warm, compassionate human being who cared a lot about his fellows and especially about the students and faculty of the Institute.

I owe a lot to Paul Eaton; if it were not for him I would not be here. Paul, who was interested in everything that went on at Caltech, in the autumn of 1951 appeared at one of the games of the Institute soccer team, which I was at that time coaching. We had so few spectators in those days that I used to thank each one personally for coming. In this way I met Paul, and we were soon firm friends.

Time marched on, and I became a graduate student and went off to India. There, I suddenly received a telegram from Paul asking if I would be interested in becoming master of the student houses. I accepted, and my professional relationship with Paul Eaton commenced.

Paul was a delightful man to work with. He was always filled with good humor. He might not always approve of what you were doing, but he never second-guessed you. His conduct of the dean's office was a wonderful blend of idealism and pragmatism. He never overadministered or exaggerated the importance of a trivial problem. I recall a disciplinary committee appointed by President DuBridge to deal with the case of a student who had engaged in carnal extracurricular activities in his room with the daughter of a prominent movie star who demanded his punishment. Paul thought awhile and concluded that as the episode took place during the young man's physical education hour, and hence was within the period when women were permitted to visit the student houses, no rule had actually been broken. Consequently, he urged that the culprit merely be asked to move out of the student houses so that he could indulge his whims more freely.

On another occasion, Paul was faced with the problem of one of the few truly detestable students ever to disfigure the Caltech campus. The problem was that this unpleasant fellow had good grades and was always within the law. Happily, this was in the days before due process, and when the young man failed physical education, a heinous crime for which ineligibility to register for the next term was prescribed, Paul convinced the Committee on Academic Standards and Honors not to readmit him.

A "down Easter" who never looked really comfortable in the West, Paul loved the sea and served the Navy with distinction during World War II. He had an encyclopedic knowledge of naval history, and when he walked he always seemed to be striding a quarterdeck. He was a wonderful conversationalist and a much sought after luncheon companion in the Athenaeum.

Paul was a true appreciator of Bourbon whiskey, and that plus the fascinating game of "mountain golf" allowed him to survive the annual visits to freshman camp at Camp Radford which he rarely looked forward to.

In his last report to the president as dean of students Paul Eaton wrote eloquently about the Caltech he loved:

> Between September of 1947 and June of 1969 very little of what I was able to accomplish was the sole result of my own efforts or abilities. Most of what can be recalled with satisfaction was achieved through the whole-hearted cooperation . . . of a host of students, professors, administrators, trustees, coaches, doctors, secretaries, resident associates, business officers, and others of the campus community.
>
> This is the spirit in which the Caltech student, whether he realizes its value at the time or not, lives and has his being during his undergraduate years. It makes possible the continued success of the Honor System, the student houses . . . student participation in the general governance, the athletic, service and cultural programs, and — one continually confides — the absence of the need to adopt disruptive means of redress of grievance.

During my early days at the Institute, I can hardly remember any major faculty committee on which Paul Eaton did not serve. He was for years a member of the Admissions Committee, and I doubt that it has ever been the same since his departure. He was also a stalwart of the Committee on Student Houses, the Committee on Academic Standards and Honors, the Student-Faculty Relations Committee, the Health Committee, the Scholarships and Financial Aid Committee, the Upperclass Admissions Committee and the Faculty Board. He was chairman of the committee which drew up the specifications for the Beckman Auditorium. As an English teacher, Paul was both demanding and popular. He was a significant example of a unique Caltech breed, the scholar-teacher-administrator.

When Paul resigned as dean of students, I was privileged to take his place. It was a hard act to follow, for Paul was a unique person. He was much loved by generations of Caltech students and by his colleagues and will be sorely missed. □

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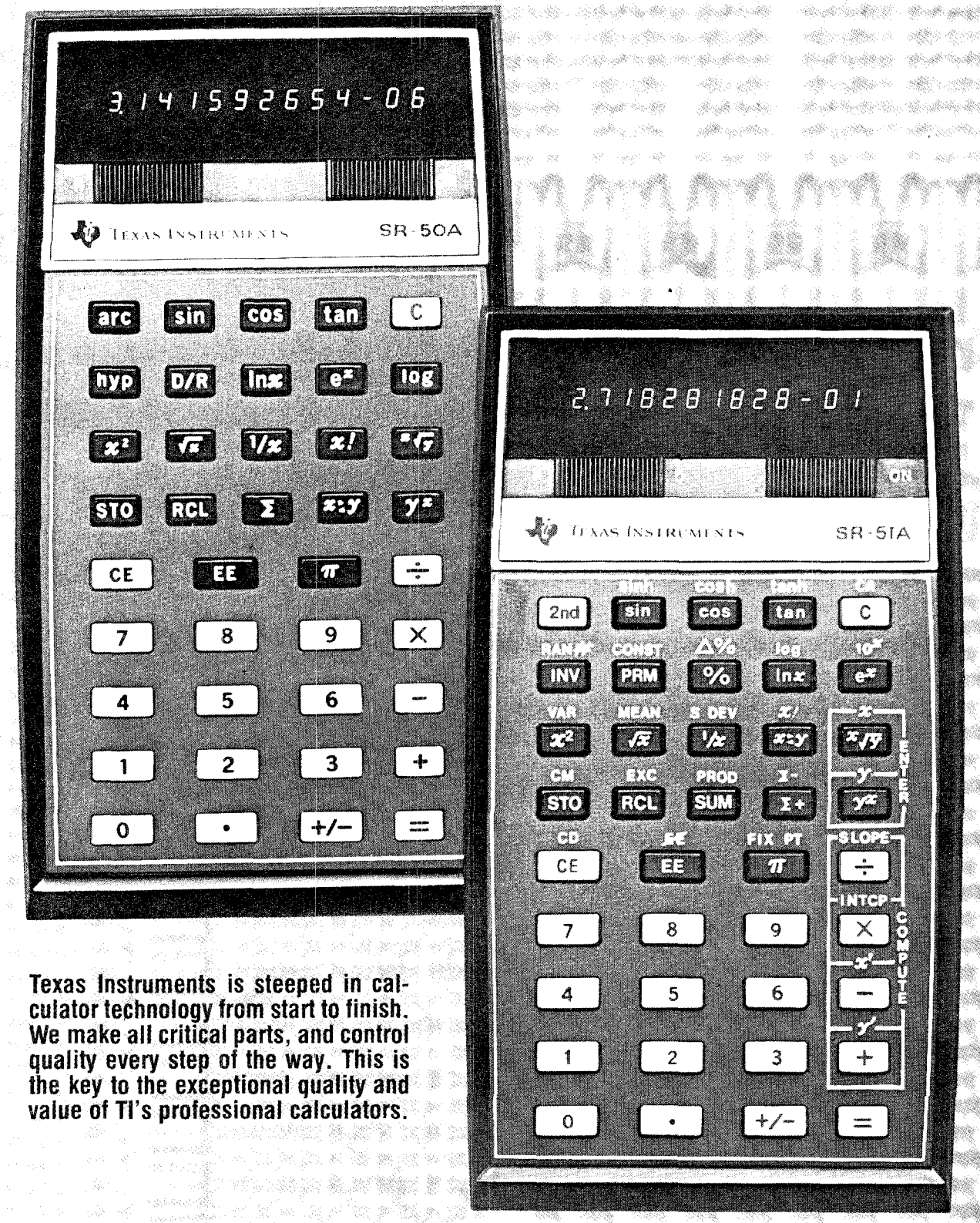

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x!	yes	yes
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Exchange x with memory	yes	no
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Trend line analysis	yes	no
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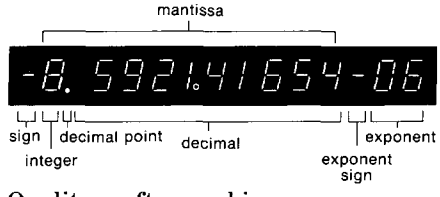

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gallons	liters
ounces	grams
pounds	kilograms
short ton	metric ton
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Today we have, increasingly, choices to make about the introduction and the directions of our ever changing technologies. And thus we have need of the knowledge and insight and wisdom of the humanists to help to guide those choices. In retrospect we can see that our continuing Baconian compulsion to introduce technical and social change has stretched the very fabric of our society and thereby exposed the concealed, yet unhealed, divisions — the ancient and continuing social faults that had been discreetly papered over, the sores of imperialism, and racism, and economic injustice.

We can see that very likely particular technologies are better adapted to particular forms of social structure. In the past, we have perforce adapted our social structure to the available technologies. Can we now begin with our wealth of knowledge to reverse this pattern, to construct technologies suited to the society in which we wish to live and the kind of man we wish to be?

Or are we, again, naive? Do we really have the freedom on this small planet to choose our technology? Is there a technological imperative, an innate entelechy that determines the course of technological evolution for which men are the unwitting pawns, much as the cells in a developing organism?

The horror in Mary Shelley's tale, *Frankenstein,* was not so much that Frankenstein's creation turned out to be a monster but that once created he could not be destroyed. Is this a parable for our science and technology? We can certainly hope not.

But at least a few scientists can see that we will need all of the wisdom we can muster. Indeed, we have so long been committed to the doctrine that change is, per se, good that we lack even the social agencies to brake or divert change. If, as an instance, we should decide that we do not wish at this time to exacerbate our existing social tensions with the introduction of a new technology, such as human genetic engineering with its imperative of difficult and divisive new value judgments, how could we divert it? If we choose to defer this technology, to what time? If we wish to ban this technology, how would we do so, globally — and at what social and spiritual cost to science and to all intellectual zest?

We need humane wisdom if we are to find noncatastrophic solutions to our growing dilemmas. We cannot simply abandon our technological craft — our life-support systems. Our very food and water and warmth depend upon them; there is no going back. Nor really, would we, if we could. Without science and technology we would still be living in the 17th century. Would anyone really take that return trip? Science has brought us wonderful, if troubling, illuminations. Technology has brought us great freedoms, even if it has also brought new torments. Agreed, we cannot continue simply to rely upon more technology to cure the evils of today's technology. We need the insight of the humanists. But also we must have the elixir of science and the thrust of technology.

We need to prepare our best students to cope with problems of whether and which, as well as how

While there are many points of contact between the humanities and the sciences, human genetic engineering is their direct intersection. The mere possibility of such a technology presents clear imperatives to both disciplines. The humanist must finally recognize that many of our peculiarly human qualities are, in fact, shaped by our genes — yes, by those tiny molecules, that were in turn shaped by eons of evolution. And the scientists must finally recognize that to reshape man is not a beguiling laboratory experiment, but an enterprise that involves the ultimate exercise in value judgment. It is to fuse means and ends; it is to test the validity of all values. To use our heritage to change our heritage is to take the full responsibility for human destiny. The potential of human genetic engineering will draw science into the mainstream of the humanities and the humanities into the mainstream of science — a most fateful union.

I should not mislead you as to the acceptance of these concerns within the camp of science and technology. There is some recognition of their validity, but it is limited. I attended an unusual conference last February, involving 150 scientists, which dealt with questions of whether and how to proceed with certain lines of research having to do with recombinant DNA molecules. The atmosphere was tense, often acrimonious, but the only focus of debate was the issue of safety, the potential uncontrollable health hazard that might be involved in the pursuit of this research. To decide upon restraint on these grounds was task enough. To have raised questions concerning the ethical or social desirability of this line of research would have been, however important, completely futile.

If we need, somehow, to blend the humanities and the sciences to cope with the problems of the modern world, how shall we go about it? How can we train individuals to be perceptive of the best of both disciplines? I will not presume to answer for the humanists. From my side I would ask, how can we train scientists to be concerned not only with science itself but also with the definition of the proper role of science in the human adventure? How can the scientist, necessarily deeply committed to his own work, learn to stand back from that work — to see that the world of science is not all-embracing but is one world, contiguous to other worlds? To see that the scientist is one facet of the human being and to see the relation of the world of science to those other worlds? To stand back and see that science exists because man — alone, so far as we know, among the animals — has the capacity to create within his cerebral cortex detailed representations of his external world, as he perceives it, and to rearrange these representations in varied modes? To see that man presumably acquired this odd talent because of the advantage it gave him in the projection of future circumstance, an obvious aid to adaptation and survival?

And to see then that the price of this capacity, the price of imagination itself, is the potential for distortion, for self-deception, even for hallucination? And that Bacon outlined science then as a reflective art — as a social compact to lead us, through the regimen of experiment, to a single, communal, openly validated perception of the universe? And to see that science is in this sense in some ways like a religion; it requires of its faithful a self-abnegation, a submission of one's individual idiosyncratic view of the universe into the single common, cumulative perception?

This is the way the world is.

No less — and no more.

But then also to see that science cannot deny the human *value* of other perceptions of the universe within the human cerebral cortex — of the aesthetic perception or the moral perception or even the fictional per-

ception, if they are recognized as such?

No scientist, only an artist, could produce fantasies that delight us by the rearrangement of the real world.

No scientist, only leaders with great moral insight, could have devised the basis of our Judeo-Christian ethics.

Nor should science claim even its own perfection, for science is self-evidently a human creation. Science exists in the human mind, and one thing we do know that Bacon could not is that the universe is far more complex than even the human brain. We do marvelously well with our abstractions and our generalizations of reality, but the true external complexity surely greatly exceeds our inherited cranial capacity.

But do we train our scientists thus? Alas, not so. It is true that our great schools of science and technology pay lip service to the humanities but not much more. At Caltech it is loosely said that each student must devote 20 percent of his course time to the humanities, but in fact only one-fourth of that need be in the humanities per se. The remainder can be, for example, economics, social science, or anthropology — all valuable in themselves, but not truly the humanities in outlook.

MIT, by virtue of its size and stature, is surely a leading symbol of science and technology. And it has often expressed its recognition of the significance of the humanities. But it is interesting to read what William Irwin Thompson, who did time at MIT, writes in his widely acclaimed book, *At the Edge of History:*

> What distinguished MIT from any other university was not its science but its overwhelming lust for power . . . . When men are trained to strive for power over their environment they are socially constrained to achieve that success through suppression of consciousness in which ambiguity, complexity, feeling, intuition and imagination are dismissed as irrelevant distractions . . . .
>
> The humanist at MIT thus finds himself in a situation that is no doubt prophetic of the condition of the citizen in the technological society of A.D. 2000. To the degree that the humanist succeeds in technologizing the humanities (by turning them into the social sciences), he destroys the humanities; to the degree that he ignores the technological world and teaches as one might at Cardinal Newman's Oxford, he insures the conviction in his students' minds that the humanities are simply irrelevant to the mastery of our new complex society; to the degree that he succeeds in communicating the relevance of the traditional humanities to our society, he finds himself welcomed by the administration as valuable camouflage, and resented by his students, who correctly point out that while he makes a great noise, he is still powerless to affect the inhumane training of the whole Institute. The naive humanist thinks that in teaching the humanities to MIT students he is helping a major American institution deal with the problems of our civilization, but it does not take long for the students to educate the teacher to see that the Institute is, as Eldridge Cleaver would say, not part of the solution, but part of the problem.

I do not know how just this trenchant critique may be, but it is of great interest as a humanist's reaction to a great technical institute. (In *Technology Review* for May 1975, Bruce Mazlish, the new head of the humanities department at MIT, presented an alternative:

> Another role . . . . is for the Department to become integrated into the full intellectual life and work of the Institute, to become involved with the people in engineering and science in trying to understand problems that are related to the creation of a new kind of world by science and technology . . . . in some ways, in the future the only way you'll be able to do good science or technology is by having a very keen awareness of the humanistic and social science component.)

Thompson, however, has a real point. The problem is, if I may borrow a term from the social scientists, one of "role models." It would do little good simply to inject more required humanities courses into the Caltech or MIT curricula. The student comes to Caltech or MIT to become a scientist or engineer; his models, then, are inevitably the great scientists and engineers who are his mentors. If they ignore the humanities — if they, as they do, make it clear that pure physics, or chemistry or biology or mathematics, is the real focus of interest and the locus of importance, then all the wisdom of the humanists will leave scant imprint. To impress the student with the importance of nonscience he must see that his role models are concerned with nonscience. The questions of the social consequences of science and technology, the issues of choice and values, must be brought into the physics and chemistry and biology classrooms so that as the student learns the physics of splitting the atom, he also ponders the social correlates of nuclear fission. And as he learns the principles of genetics, he also learns of the reality of environmental mutagens and ponders the significance of innate human diversity.

I do not pretend that I know how to bring this about — but I do believe that we need sorely to develop an educational style that will prepare our best students to cope with the problems of whether and which, as well as how. When we have accomplished that, perhaps we will see more clearly the relation between science and humanities that I feel is depicted in the famous photograph from Apollo 8 of our earth rising over the lunar horizon.

Here, the power of science has provided us with a simple, dramatic confirmation of the ancient humanist vision of the common bond, the common solitude, the common destiny of all mankind on this small Eden floating in the vastness of space.

The vision of the scientist need not eclipse that of the humanist — nor vice versa. Rather they should complement and reinforce each other as we find our way into the future. □

Just what are our problems? It seems to me that our fundamental economic problems are not basically economic at all, but rather social and political. People generally have expectations or appetites that are larger than our capacity to produce, and these expectations are constantly rising. This in itself is not necessarily bad — within reason, it can be good. What is bad is that we have come to the point where we think we can have everything we want, and all at the same time, and immediately.

Whether because of rapid communications by radio, TV, and satellite, or because of political promises that have not been, and probably cannot be, fulfilled, or because of unrealizable desires fanned into supposed needs by advertisements, or the competition of labor union leaders for position, or the impractical evaluations of present conditions and the solutions proposed, therefore, by some academicians, or a combination of these — or for whatever reason one chooses to put forward — the hard fact is that too many people want instant gratification.

The hard fact is that too many people want instant gratification

Not having learned the most important lesson of economics — that there is no such thing as a free lunch — they too often expect their desires to be provided by others, usually government, rather than through the old-fashioned route of hard work and thrift. They don't just think it would be *nice* to have "everything." They demand it as their *right* — practically guaranteed by the Constitution, if not even higher authority.

And what is the result? When they find that collectively we can't get a quart out of a pint bottle they first become disappointed, then disenchanted, and then alienated. They want to somehow strike back at government, big business, the establishment, or anyone or anything except themselves. This is popularly called a "general malaise."

So we continue our spending spree. In the private sector, the "Buy Now, Pay Later" syndrome has infected the whole country. We are deluged with messages not to wait until we have *earned* money, but to borrow it on the "easy" payment plan and enjoy instant gratification. Buy a fur coat; take a trip to Europe; do anything your little heart desires — you're entitled to it. And don't worry about paying for it. Perish the thought!

Instant gratification is often short-lived, and soon superseded by the "misery" perceived so long ago by Charles Dickens's Mr. Micawber: Annual income twenty pounds, annual expenditure nineteen pounds, nineteen and sixpence. Result: happiness. Annual income twenty pounds, annual expenditure twenty pounds, no shillings and sixpence. Result: misery.

In the public sector, we also spend more than we take in, leading to government deficits and directly to inflation. People complain about inflation, but when demands cannot be met from current income we go into debt as individuals and governments and rely, consciously or unconsciously, on inflation to bail us out. Almost everyone is against inflation until stopping it begins to hurt *them*. Meanwhile, they look for ways to protect themselves against the effects of inflation. Collectively, it can't be done. (Some people thought the stock market was a hedge. Was it? How successful was it for people who needed the money *now*, and couldn't afford to wait for a hoped-for upturn?) The only way to hedge against inflation is to stop it in its tracks!

But, just as we never seem to learn from past mistakes, so do we continue to try the old nostrums — wage and price controls, strangulating government regulations, taxation policies that result in disincentives for increased productivity — and we tolerate a continuance of make-work featherbedding rules and wage and price rigidities imposed by unions and employers.

It seems to me that our fundamental economic problems are basically . . . social and political

Of particular relevance to the subject at hand, we allowed ourselves to be led down the garden path of the "new economics," a prime example of a catchy slogan prevailing over reason. This philosophy called for deliberate deficit financing, even in periods of relatively high economic activity, in an endeavor to expand such activity further and faster. Discretionary fiscal actions were accorded a major role in attaining and sustaining "full employment." Such concepts as "full employment budget" and "fiscal drag" were supposed to justify the view that a Treasury surplus prior to "full employment" would be equivalent to economic disaster.

Certainly, new ways of analyzing the impact of federal fiscal operations can always be helpful. Right today, a clarification of the impact which might be expected from the huge federal deficit now in view for fiscal 1976 alone would be most welcome. However, I think it can be said without risk of contradiction that the new economics fell far short of the claims of its proponents, and in fact could actually be blamed for a substantial portion of the inflation problem. When policies of stimulation have outlived their usefulness, the very newest of economic approaches doesn't result in "right now" ever being the acceptable time to apply restraint. Politically, it is so much easier and more pleasant to apply stimulus than to slow down an economy and return it to noninflationary bounds.

It seems to me that we should seriously question the basic premises of the thesis that government planners can tune the economy so as to assure steady growth in employment and productivity, while at the same time maintaining a sound dollar. These premises seem to be:

1. Economists now have sufficiently accurate information to predict whether the government should be pursuing expansionary or restraining policies;
2. This information is available in time to be of practical use;
3. The fallible human beings who make the decisions for the government based on these data will make the right economic decision rather than the politically expedient one; and
4. These decisions will be made promptly at the right time.

Does recent history give us confidence that any of these four premises, much less all of them, will be met in this practical world of ours? On the contrary, is there not some reason to feel that governmental actions in recent decades have been more unstabilizing than stabilizing? In fact, it might be concluded that no government planning is better than wrong government planning. We must keep trying to solve our problems, but I would hope that less dependence could be put on single national planning and deci-

sion and more on individual planning and decision, thus giving ourselves a better opportunity to achieve a viable and flexible balance. The result *might* not be as good as a single *brilliant* government decision, but far better than a government blooper.

Where the problem of unemployment is concerned, I yield to no one in recognizing the tragic human consequences involved when people who are able and willing to work cannot find jobs. But I see no trade-off between inflation and unemployment. In the long run, we must have *neither* or we'll have both — as is being demonstrated at the present time. Surely, an unemployment rate in the area of 9 percent, and a recent inflation rate more than double the rates prevailing just prior to the 1973-74 price explosion, tell the story all too clearly.

What could help reduce unemployment in one year is not necessarily the answer at another time. Even in the short run, it is very doubtful whether general expansionary policies could be effective in materially reducing any prospective unemployment which our economy might encounter. Specific measures would be more appropriate, such as training, relocation and, if necessary, even a soundly conceived and properly financed public employment program, supplemented where necessary with expanded unemployment benefits. None of these would be as harmful or nearly as expensive as overstimulation of the whole economy at every turn. Any future unemployment which might accompany the adoption of sound policies would not be the result of these policies, but would more likely be caused by the continuation of wage, price, and other rigidities. In any event, such temporary unemployment would be far less severe than the unemployment that would inevitably follow a continuation of our pattern of excesses over the years.*

As of the time this article is being written (and who knows what may happen by the time it appears in print) the economy seems to be in the process of turning upward. It is important to note — if it happens — that the upturn started *before* there could be any real impact from a prospective $70 billion deficit in the Federal budget. Of course, this won't stop the apologists for the New Economics from asserting that it was the fiscal stimulus that turned the economy around and reduced unemployment, while inflation was being reduced to "only" 7 percent. Some are already arguing that we must increase and continue the fiscal stimulus to avoid "aborting" the recovery. They piously say that we can worry about the inevitable inflation later — always later, never now.

Nor will these dreamers find any difficulty in ignoring the facts and ascribing the inflation and high interest rates that will inevitably result to some cause, however unlikely, other than that same "fiscal stimulus"! Some people never learn. Let's hope the huge deficit *already* contemplated doesn't set back a truly sustainable recovery by several years.

Here's one possible blueprint for a brighter future

Is the situation hopeless? No. There is yet time, though it's getting short. Here's one possible blueprint for a brighter future:

1. If we as a nation could remember basic principles and resist slogans, perhaps we could at last reduce unreasonable expectations of what government and others can do for us, and concentrate on the importance of earning our own way. We might even take the first steps down the road to recognizing that the essence of liberty is self-discipline. If we can't discipline ourselves, the only alternative to anarchy is for someone else to do our disciplining for us. I hope an appeal to the time-tested principles of hard work, thrift, and integrity will not fall entirely on deaf ears, especially now when we have witnessed so many recent examples of the sad results of neglecting these time-honored guideposts. If enough of us demand higher standards of integrity and competence all along the line — from government, business, education, and labor — we'll get them.

2. Let us come to grips with the necessity for business and labor to increase production, productivity, and savings, and to emphasize the use of credit for sensible and productive purposes. These are the only reliable sources for the capital needed for housing, business plant and equipment, and for the funds which make social security and other transfers possible.

3. We must mount a massive campaign to conserve our natural resources, especially energy, to find new sources of energy, and to become much less dependent on foreign oil.

4. It's long past time to do something about the restrictions on production imposed by union-fostered featherbedding rules, jurisdictional disputes, and attendant rigidities.

5. We need to follow sensible policies to reduce specific pockets of unemployment and relieve the human suffering caused by any remaining excessive joblessness, without aggravating the future problem of unemployment. As a starter, it would be a tremendous help to have reductions in excessive government regulations and union monopoly powers, and flexible pricing and wage policies responsive to changes in costs, demand, and other factors. Unless such flexibility is free to operate on the *down* side when appropriate, as well as on the *up* side, inflation is a foregone conclusion.

With particular reference to the housing recession, it would be helpful if government and others would wake up to the fact that builders, labor unions, and land speculators are pricing new homes — and thus themselves — out of the market, with a big assist from increasing real estate taxes. Additional government subsidies to transfer the higher interest rates caused by inflation from the home-buyer to the taxpayer merely weaken what restraints there are on rising costs, and thus aggravate inflation still further. The price of the house and land is the primary factor in the cost of a home — the higher it is, the higher the mortgage payments will be. Some flexibility on the down side in wages and prices in housing, together with amendments of obsolete building codes and higher productivity could soon change this picture completely around.

6. Finally, we must face the hard facts that as a nation we have no choice in the immediate future but to adjust to a somewhat lower standard of living, or at least to a reduced rate of increase in such a standard, although it is still higher than that of any other nation in the world by most measures.

Each individual American citizen has an important role to play, especially by his own prudent actions in the market place, by what kind of education he prefers and supports, by what kind of representative he votes for and supports at all levels of government, and by what he tells these representatives that he wants to see accomplished. We can't blame our representatives in government too much if we don't express our views and let them know where we stand on important issues. They do what they think we want them to do. They do listen. It's time for us ordinary people to get into the act.

There's no such thing as a free lunch. □

*To add a technical footnote, the only kind of inflation that can even temporarily reduce unemployment is a continually increasing rate of inflation. Merely to state the case proves its absurdity.

Speaking of...

Speakers

When the National Science Foundation celebrated its 25th anniversary last spring, Caltech's Institute Professor of Physics, William A. Fowler, delivered a Happy Birthday address, "A Foundation for Research," describing some of the many scientific advances that have come about because of NSF support.

As we all know, Dr. Fowler is an articulate and a graceful speaker, but it remained for R. J. Mackin, Jr., Manager of JPL's Space Sciences Division, to remind us that Fowler sometimes speaks pure poetry. As evidence, Mackin has simply taken a short passage from Fowler's NSF address and, without changing the wording in any way, set it in verse form:

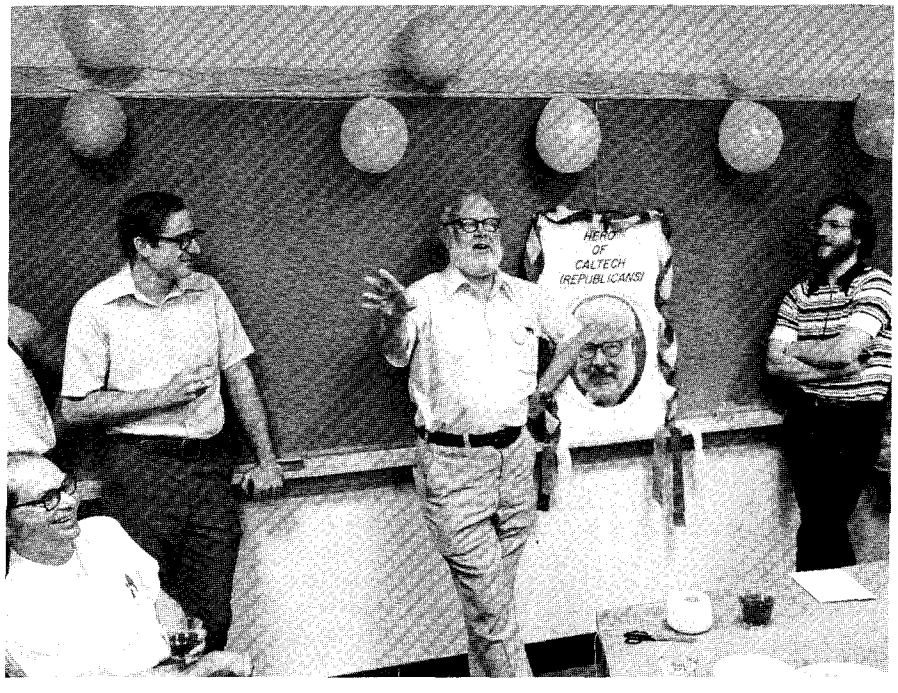
RESONANCE

The realization
That the red giant stage
Of stellar evolution
Involved helium burning
Which transforms helium
Into carbon and oxygen
Was just as far-reaching
As the discovery
That the main sequence stage
Involves the conversion
Of hydrogen into helium.
This understanding
Of the red giants
Led to the prediction
Of an excited state
In the carbon-12 nucleus.
This state
Was subsequently found,
And we now know
That it determines
The ratio
Of carbon to oxygen
That exists
In the Universe
And on which
All life,
Including ours,
So critically depends.
Without the resonance
In the first stage
Of helium burning
Provided by this state,
The final result
Of the burning
Would be all oxygen;
There would be
No carbon
From which to construct
Amino acids and proteins,
And where would we be?

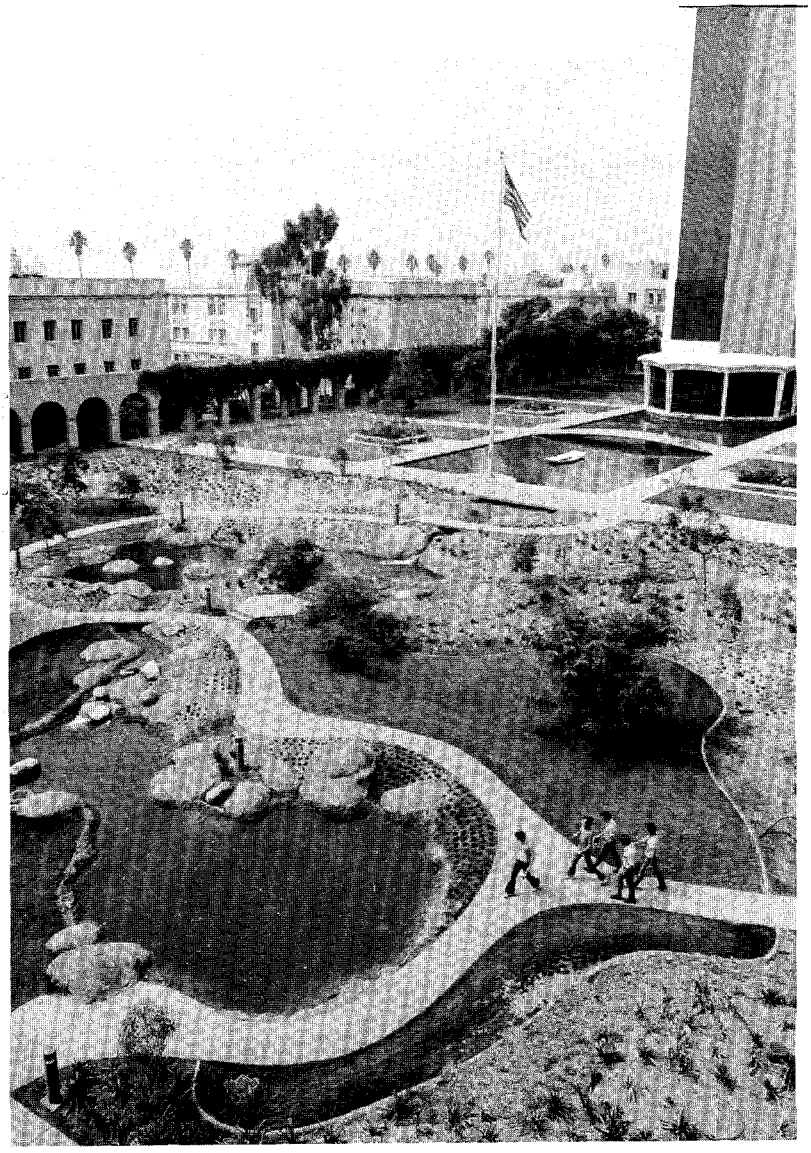
William A. Fowler

Speaking of Fowler, he was awarded the National Medal of Science at a White House ceremony on September 18. This is the highest award of the federal government for distinguished achievement in the mathematical, physical, biological, or engineering sciences.

The National Medal of Science was established by Congress in 1959 and was first presented in 1963—to Theodore von Karman, professor of aeronautics and director of the Guggenheim Aeronautical Laboratory at the Institute from 1930 until his retirement in 1949. Since 1963 the medal has been given to five other Caltech faculty members: Alfred H. Sturtevant, professor of biology, in 1968; John R. Pierce, professor of engineering, in 1971; Allan R. Sandage, staff member of the Hale Observatories, in 1971; A. J. Haagen-Smit professor of bio-organic chemistry, in 1973; and Linus Pauling, professor of chemistry emeritus, in 1975.



Caltech's Kellogg Radiation Laboratory gives a welcome home party for William Fowler, fresh back from Washington with his brand new Medal of Science.

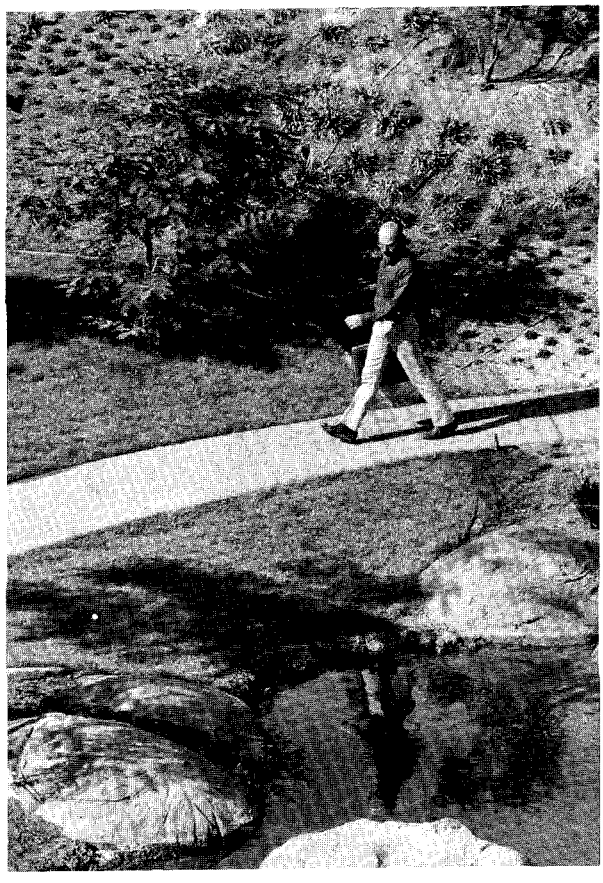


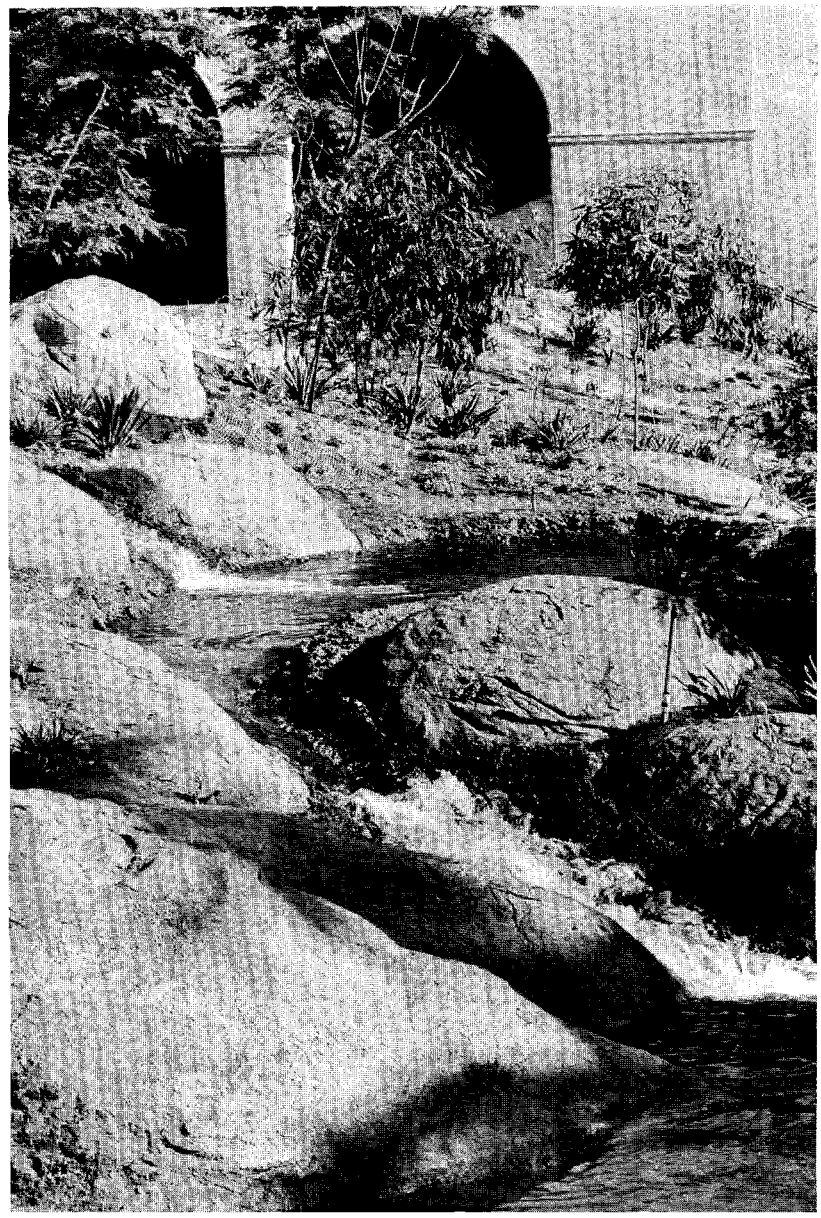
The Throop Site

Old Throop Hall went down under the wrecker's ball in 1973, and the site where the grand old building stood has been barren indeed ever since. The original plan, approved by the trustees, was to build a broad concrete stairway leading down from the Millikan Library level to the Throop Alley level. But just as construction was about to start, a group of students and faculty asked for a moratorium on concrete, and offered a plan in which water would be the principal medium instead.

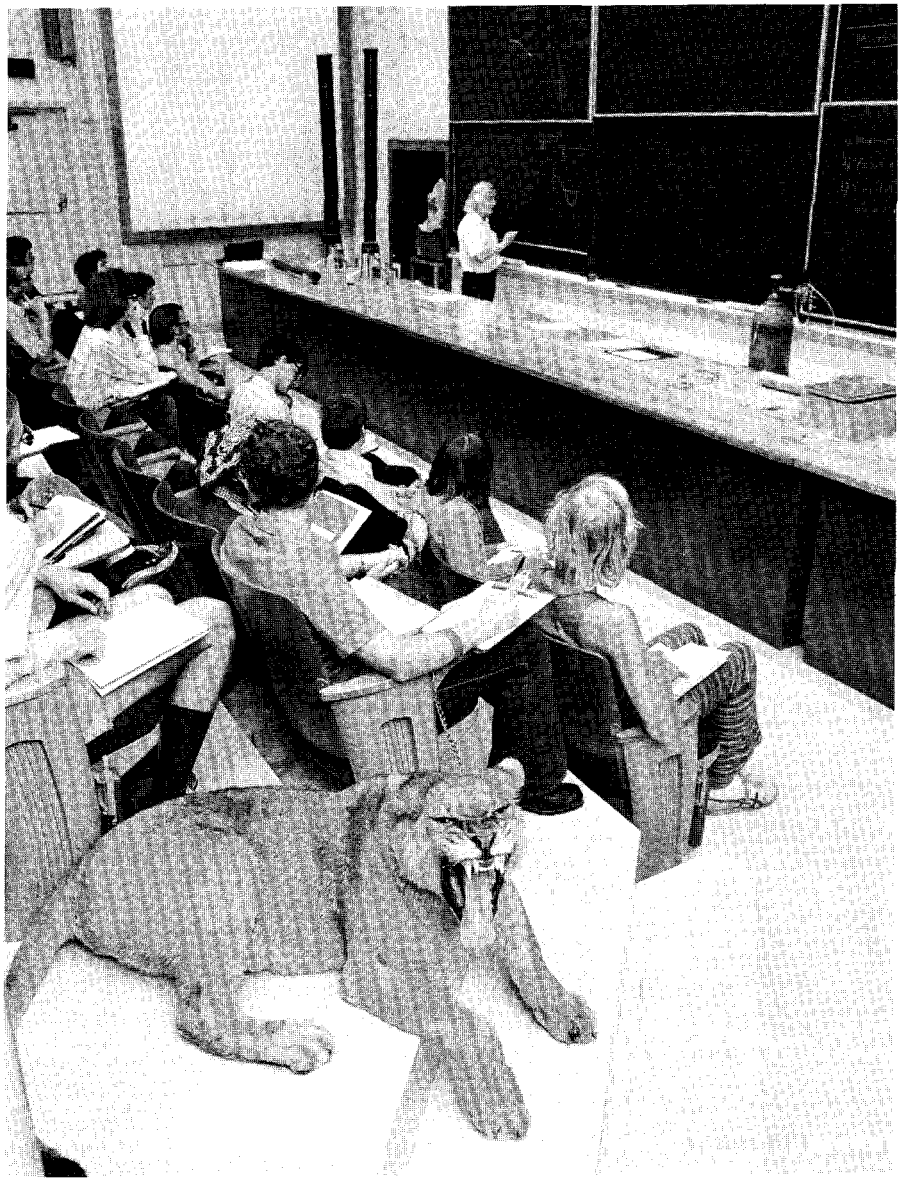
The end result is now on view. The plants have some growing to do, and the pools have yet to be stocked with fish and plant material, but the Throop site is now a miniature park, with winding paths, cascading brooks, quiet pools, and man-made rocks (manufactured on the spot).

One colorful feature of the site is a stately $2,000 cedar deodar, donated by the Cleveland Wrecking Company to give Caltech students a permanent Christmas tree—replacing the one that Cleveland had to remove from the dome of Throop Hall when they started to bring the building down in December 1972.





Duchess arrives on campus in Phil Engelhauf's van—and finds, on an extensive campus tour, that a freshman physics lecture is not exactly a highlight.



Lions

Phil Engelhauf came to Caltech as a freshman last year, but he left his roommate and constant companion, Duchess, back home in Riverside until the end of the school year. Then, as a special treat, Phil brought Duchess to campus for an overnight visit, which included a chance to hear a freshman physics lecture by Ricardo Gomez (below). In class, and throughout her visit, Duchess was well-behaved, though occasionally bored, and always remarkably patient with the crowds that seemed to regard her as some kind of curiosity. After all, she is just an adolescent (about 20 months old) 200-pound lion who has been part of the Engelhauf family ever since she was a cub.

Duchess's visit to campus was not just an idle whim of Phil Engelhauf's. In fact, it made a good deal of sense as originally planned.

All year, Phil had been going to biology class. And all year the instructor, James Bonner, had been accompanied in class by his beautifully behaved schnauzer. To end the year, Phil thought he ought to bring *his* beautifully behaved pet to Bonner's classroom. But things didn't work out because Duchess balked at going into the biology building, and when Duchess balks—that's all, brother. So Phil had to go on to his next class, which was physics, and Duchess had no qualms about walking into the physics building—which is how she came to hear a physics lecture by Ricardo Gomez.□

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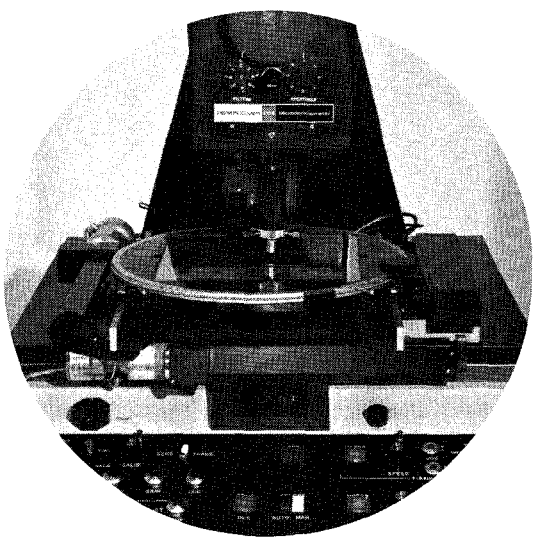
and you COULD have them all.....but,



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