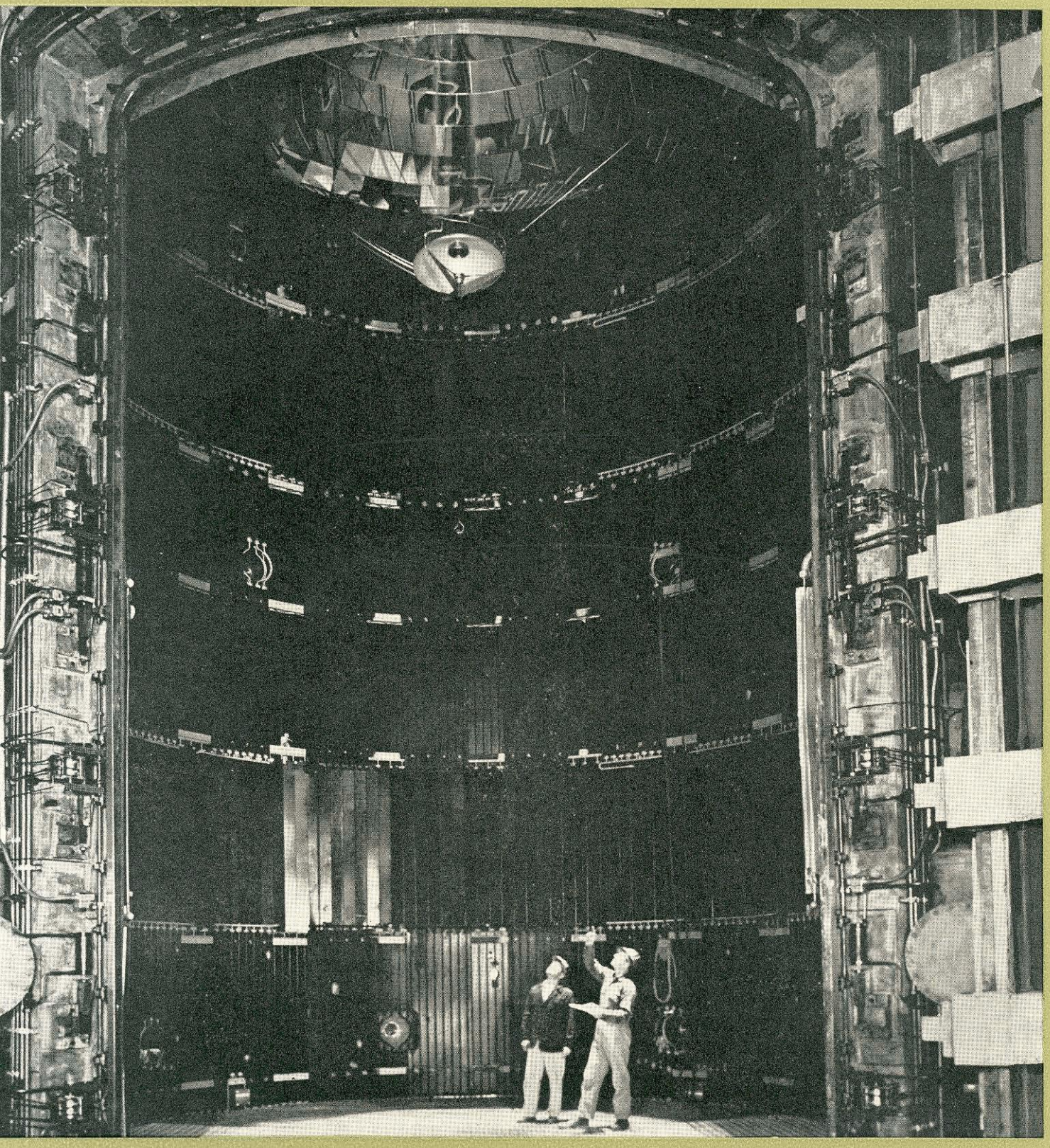
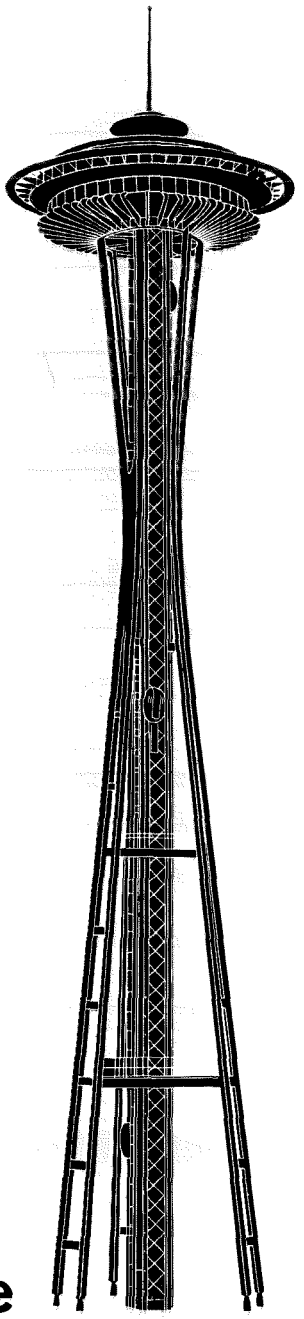
ENGINEERING | AND | SCIENCE

March 1962



JPL's space simulator . . . page 24

Published at the California Institute of Technology



revolution in space

This amazing structure symbolizes the outer space theme for this year's Century 21 International Exposition in Seattle, Washington. Called the Space Needle, it soars 600 feet into the air on three steel legs, tapers to a slim waist at the 373-ft. mark, then flares out slightly to the 500-ft. level, and is crowned by a mezzanine, observation deck, and a 260-seat restaurant that *revolves* slowly (one complete revolution an hour) while patrons enjoy their meals.

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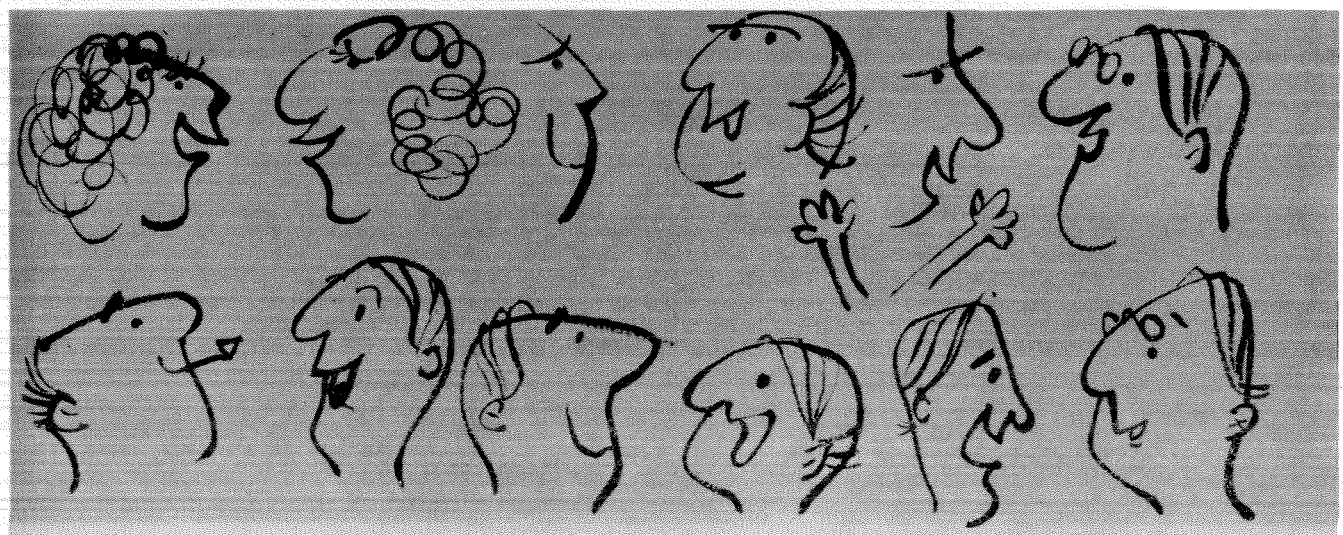
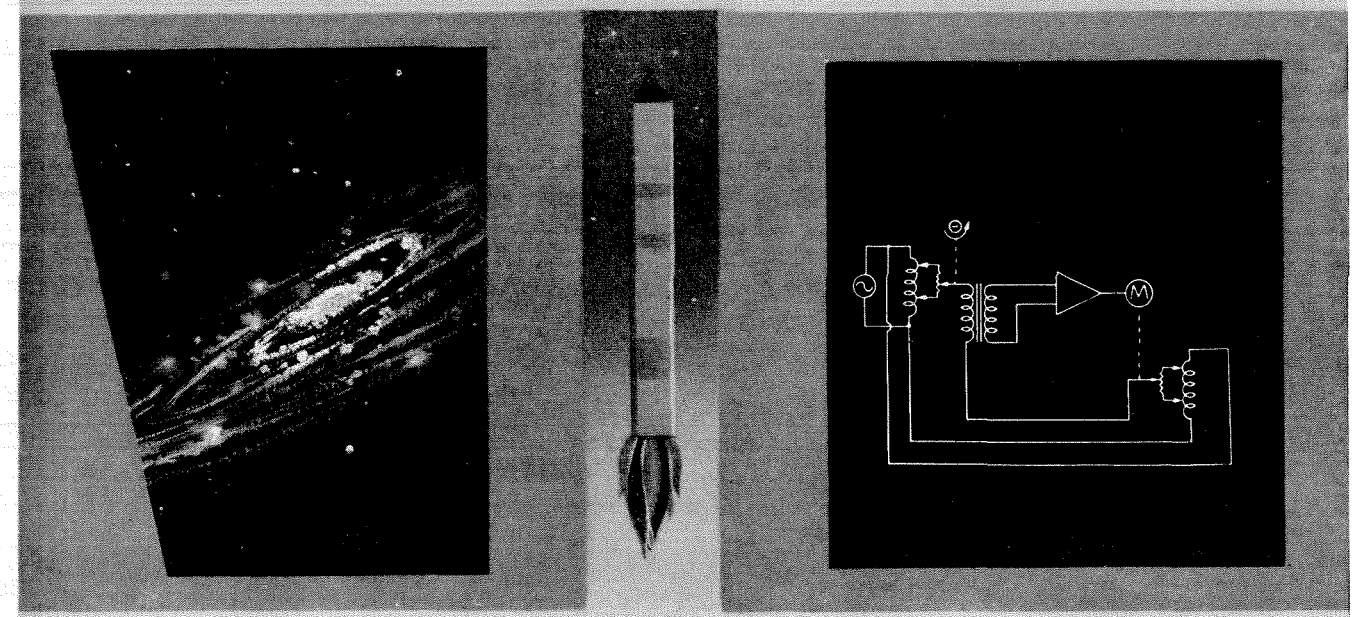


COMMUNICATING SIMPLE IDEAS IS HARD ENOUGH...



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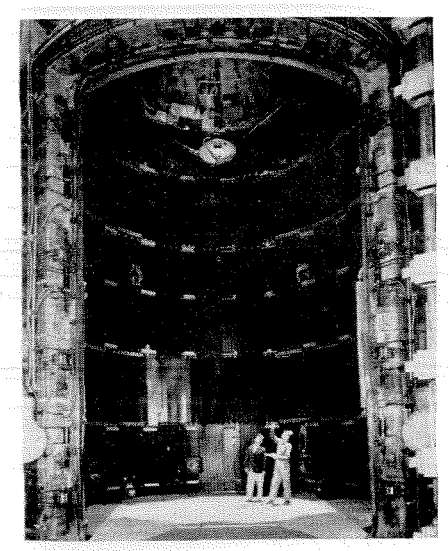
MARCH 1962 VOLUME XXV NUMBER 6



On Our Cover

The largest space simulator in the United States has been built by Caltech's Jet Propulsion Laboratory to test spacecraft in the environment they will encounter on long trips to Venus or Mars. For more about the simulator, see page 24.

Robert F. Minckler,

chairman of the Caltech Board of Trustees, originally gave "The Cold War" (page 11) as a talk at the Twilight Club in Pasadena on January 30. Mr. Minckler has been a member of the Board for eight years, and a member of the California Institute Associates since 1948. He was president of the General Petroleum Corporation in Los Angeles for 12 years, until his retirement in 1960. He is a native of Minneapolis, Minn., and an alumnus of the University of Washington.

Theodore J. Voneida,

research fellow in biology, is the author of "Investigating the Brain – Its Structure and Function" on page 17. He came to Caltech after receiving his PhD from Cornell University in 1959. His special field of study is neuroanatomy.

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A new Van de Graaff accelerator has appeared on the scene. It did not spring full-blown from the brow of an inspired design engineer and, in fact, bears a remarkable resemblance to its predecessors. It evolved rather from both an inspired customer's need and improved state of the art. The KN-4000, at *4 Mev*, does fill in a gap in the voltage range of standard equipment. It offers great versatility of use, low installation cost, and delivers a very respectable *400 μa* of current at rated voltage. A convertible machine, it will also accelerate a full milliampere of electrons (*4 kilowatts*).

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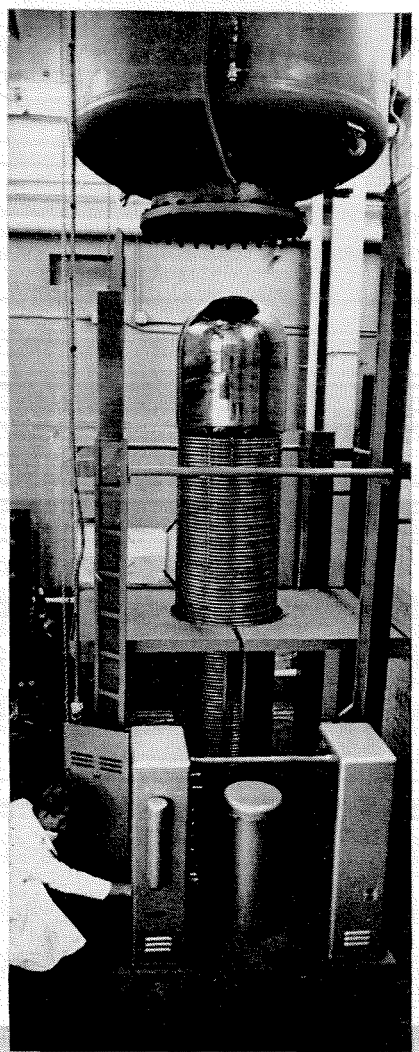
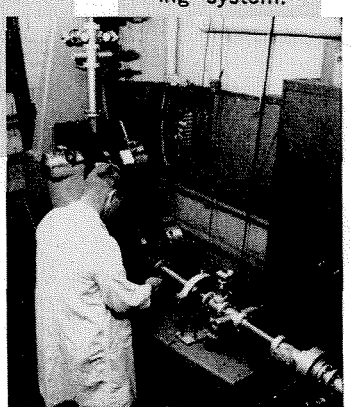


Terminal and accelerating section of the KN-4000 Van de Graaff with pressure tank removed.

Precision 90° analyzing and stabilizing system.



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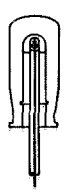

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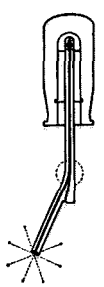

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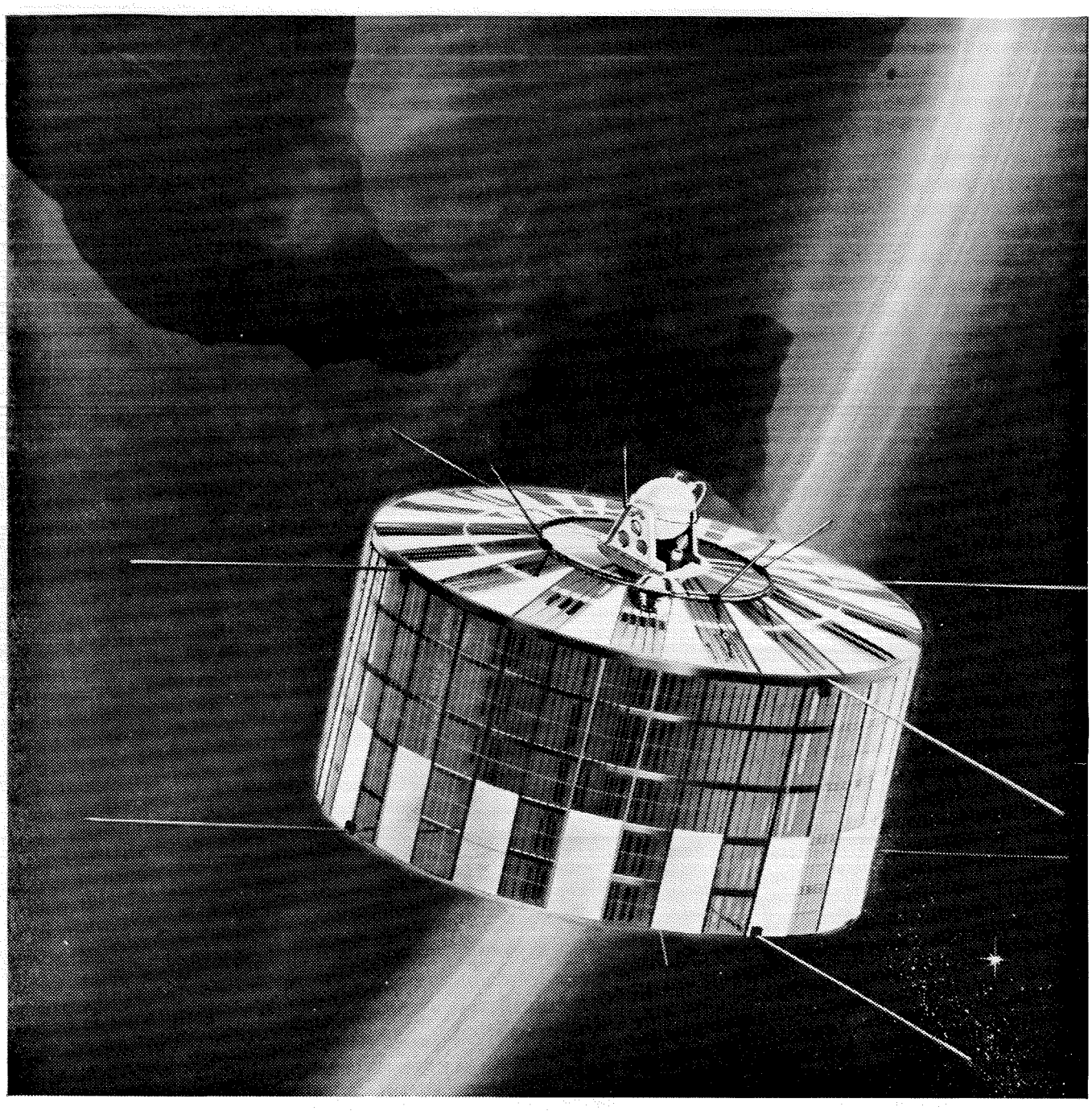

Illustration Courtesy The Martin Company

Atomic power for outer space

Monsanto . . . a world leader in chemicals, plastics and petroleum products . . . has also taken a giant step into the atomic space age. Now broadcasting signals from space is a *Transit* satellite transmitter, powered by an "atomic generator." This long-lived power source is fueled with plutonium 238 processed and encapsulated at Mound Laboratory, which Monsanto Research Corporation, a wholly owned subsidiary of Monsanto, operates for the Atomic Energy Commission.

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Books

The Legacy of Hiroshima

by Edward Teller with Allen Brown
Doubleday and Company . . . $4.95

Reviewed by Cushing Strout, associate professor of history

A brilliant scientist and influential fighter in what C. P. Snow has called "the corridors of power," Dr. Edward Teller has resigned as director of the Livermore Laboratory to use his considerable power of persuasion on the public mind. "The legacy of Hiroshima," he thinks, has been a pessimism about the nuclear age which has crippled America in the "cold war." Scornful of test-ban and disarmament negotiations, Teller urges a program of continued testing, public shelters, and limited nuclear war. Seldom has a self-styled optimist presented such a gloomy brief for "progress."

Teller first played a major role in nuclear policy during the struggle over the decision to make the H-bomb in 1949-50. During the war he had worked at Los Alamos, but his obsessive concentration on the problems of a thermonuclear reaction had sidetracked him from the top-priority effort to produce the atomic bomb. The decision of the General Advisory Committee of the AEC to oppose in 1949 a crash program for the development of the "super" provoked him into strenuous advocacy of his long-cherished dream of making an H-bomb. He took his case to the Joint Congressional Committee on Atomic Energy, the AEC, and prominent Air Force scientists and generals, interested in strategic bombing as the key to national defense. In June 1951 he presented a new approach which convinced previous skeptics that he had found a feasible method for developing the new fusion weapon, a thousand times more powerful than the fission bomb.

Passionately dedicated to his own ideas, Teller does not forgive fellow-scientists, like Oppenheimer, Fermi, and Bethe, for their skepticism. He is sure that if they had been as enthralled as he was with the dream of making an H-bomb, the United States could have developed it sooner. The short answer to this charge is that one of his strongest defenders, Lewis Strauss, former chairman of the AEC, told reporters in August 1960: "We developed the hydrogen bomb in about three years, which is certainly par for the course. I think surely it was developed as soon as the most optimistic thought it could be done."

Some ironies

There are many ironies in this backstage drama. It was Robert Oppenheimer who secured a clearance for Teller to work at Los Alamos (he had relatives in occupied Hungary); it was Teller and his powerful supporters who testified adversely against Oppenheimer in the hearings before the Personnel Security Board which in 1954 branded him a security-risk who had supposedly failed to give "enthusiastic support" to the H-bomb program. (This gamey episode of the McCarthy era, which still rankles in the scientific community, is conspicuously missing from Teller's story of his career.) Teller did not appreciate the military and political reservations which led the skeptics of the "super" to worry about the needs of a balanced defense system and therefore to pay attention to the tactical use of atomic weapons and continental air defense. Now he pleads for tactical use of nuclear weapons in limited war and opposes the Dulles theory of strategic "massive retaliation" which the crash program for the H-bomb helped to stimulate.

Limited nuclear war

Teller wants continued testing in order to further develop mobile nuclear weapons for tactical use against enemy forces in the field. He is convinced that only first-use of these weapons, in wars with limited objectives in limited areas, can stop the Soviets. He argues, however, that limited nuclear wars should only be fought in aid of governments which are strongly rooted in popular support and clearly committed to our side. But these political conditions apply mainly to Western Europe, and it is in these densely populated areas that it would be most difficult to discriminate military targets from industrial and civilian centers. Where the stakes are so high a Teller-war might all too easily "escalate" into a major conflict. His strategy appears to make military sense only in areas which fail to meet his own political conditions.

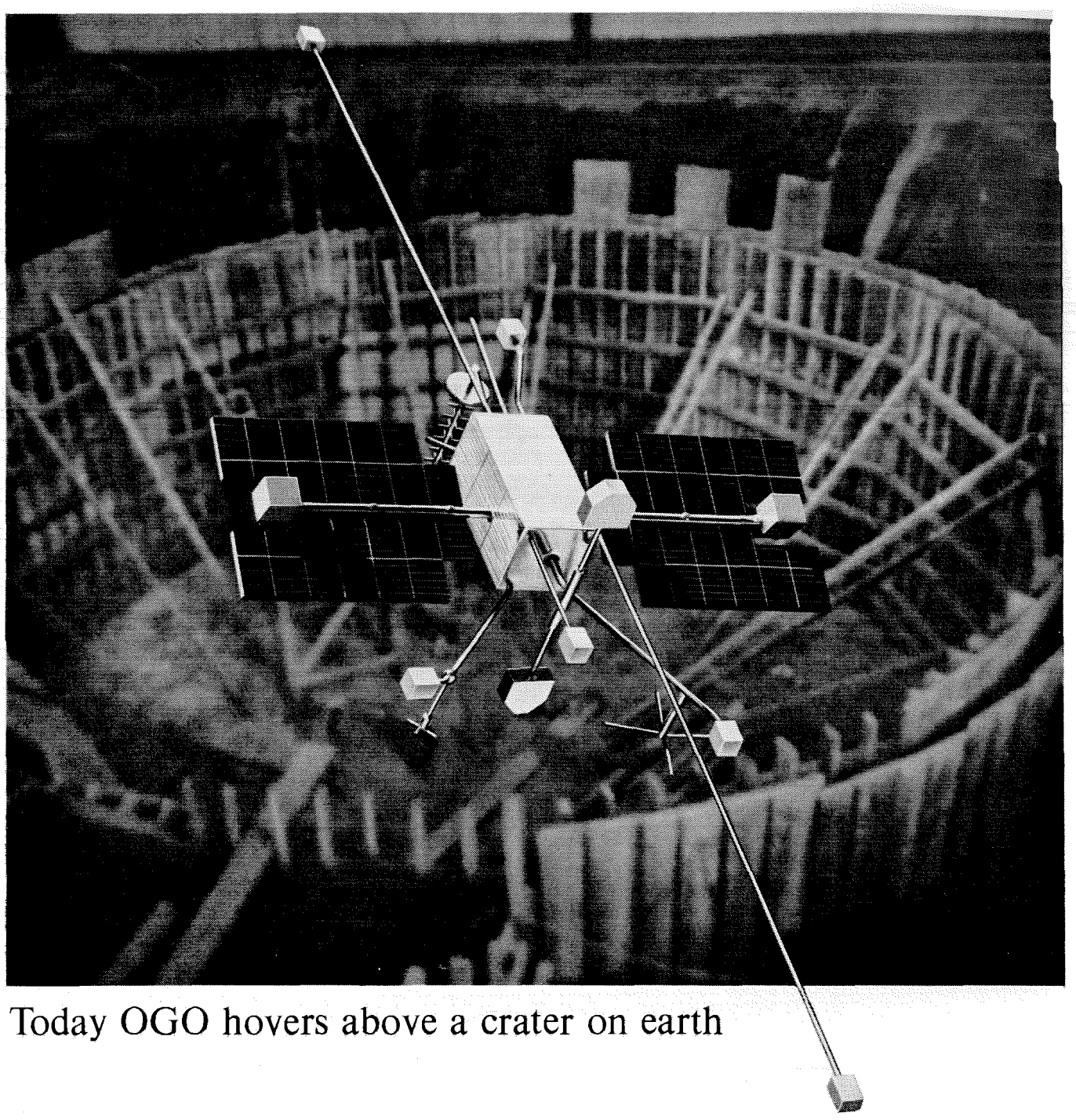
Teller calls himself an optimist, but the label is only half-true. He finds current science fiction too pessimistic, yet his optimism has a science fiction quality. He says nothing about the dangers of accidental war through misunderstanding, provocation, or "escalation"; he is confident that the whole American industrial plant could be rebuilt, after total devastation, in merely five years; and he assures us that mutations produced by fallout will ultimately be beneficial, though "offensive at first sight."

Some Soviet successes?

The other side of this curious cheerfulness is an equally exaggerated pessimism about the Western position in the cold war. He credits the Soviets with much more success than they have earned: "World Communism, up to now, has gone from victory to victory." Is Khrushchev really pleased by the Yugoslavian, Chinese, and Albanian rifts in the Communist camp? Is he happy to have been compelled to crush the Hungarian Revolution? Can he take any pleasure in the demonstrated failure of the East German regime to hold the loyalty of its people? Does he gloat over the astounding economic revival of Western Europe? If these are Soviet victories, he should pray for defeats. Teller admires the real achievements of Soviet science and education, but he is as gloomy about the status of the American scientist as if this were not the age of the Affluent Professor, the powerful scientific adviser, and the post-Sputnik infatuation with science.

Teller's tone throughout his book is that of a voice crying in the wilderness. But, by his own record, the wilderness is Washington and the voice has been heard. His agitation for a "second laboratory" at Livermore was successful, though Los Alamos actually built the H-bomb. Lewis

continued on page 8



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Books . . . *continued*

Strauss took him to President Eisenhower in the summer of 1957 to make the case for continued testing in order to develop a "clean" bomb; and Teller had the sympathetic ear of his friend John J. McCone when he was chairman of the AEC. In the mass media, Teller's views are given very respectful attention, and the current pressures for resumption of atmospheric testing and for a fallout shelter program reflect his doctrines.

He pictures an imaginary American chorus of unilateral disarmers and conjures up the bogey of "a surprising number of people who profess a preference for crawling to Moscow in surrender rather than risking the dangers of nuclear war." In sober fact, where do such people have influence, outside the pages of popular novels like *Advise and Consent*? Most Americans who have realistic worries about nuclear war are fearful that they may be the real voices in the wilderness, while the nuclear "optimists" whisper in the ears of men of power.

Some inferences

Teller has an unscientific tone of dogmatic certitude about matters in which, like the test-ban, he has no real interest. He was sure that the Soviet Union during the moratorium on testing "never did stop nuclear tests but was conducting experiments all along." Open testing by the Soviets has merely confirmed his opinion, and he is now sure that the Russians are ahead of the West in arms developments. These inferences are not provable. There never was any scientific evidence that the Soviets were secretly testing during the moratorium, and advocates of the test-ban were not, as he seems to think, deluding themselves that they had found a foolproof system. They were balancing estimated risks and seeking a limited system of inspection to deter cheating, to check nuclear diffusion, and to inhibit the arms race. They were looking primarily for a first step to test good faith and to provide a symbol of serious interest in later disarmament negotiations.

Teller joins other men of good will in praising the Peace Corps, cultural exchange programs, nuclear sharing with our allies, the Common Market, and UN police actions. But on these topics he has little to say that is searching, detailed, or original. For the rising insecurity produced by the arms race he has no practical or concrete solutions. He preaches World Government and "openness" in all societies as the one true answer, but this simply substitutes long-range goals for hard thinking about the steps that might move us from a precarious present towards a more secure future. Hailed in some quarters as a hard-headed "realist," he shows himself in this book to be a utopian who fails to appreciate the close connection between means and ends.

C. P. Snow has praised scientists for their built-in sense of the future, which policy-makers neglect at their peril. *The Legacy of Hiroshima* is vivid proof that the vital point is what kind of a sense of the future the scientific adviser has. Teller persuasively criticizes the atomic bombing of Japan without warning, but this admirable feeling for missed opportunities to restrain the use of violence seems to have faded away with his dedication to the H-bomb. Other scientists, including several who played an important role in the scientific evolution of the thermonuclear bomb, have a quite different sense of the future. It worries some of us that during the last ten years they have had less influence than Teller in "the corridors of power."

ALUMNI BOOKS

Flora of the Santa Cruz Mountains of California

by J. H. Thomas '49

Stanford University Press . . . $8.50

Flora of the Alaskan Arctic Slope

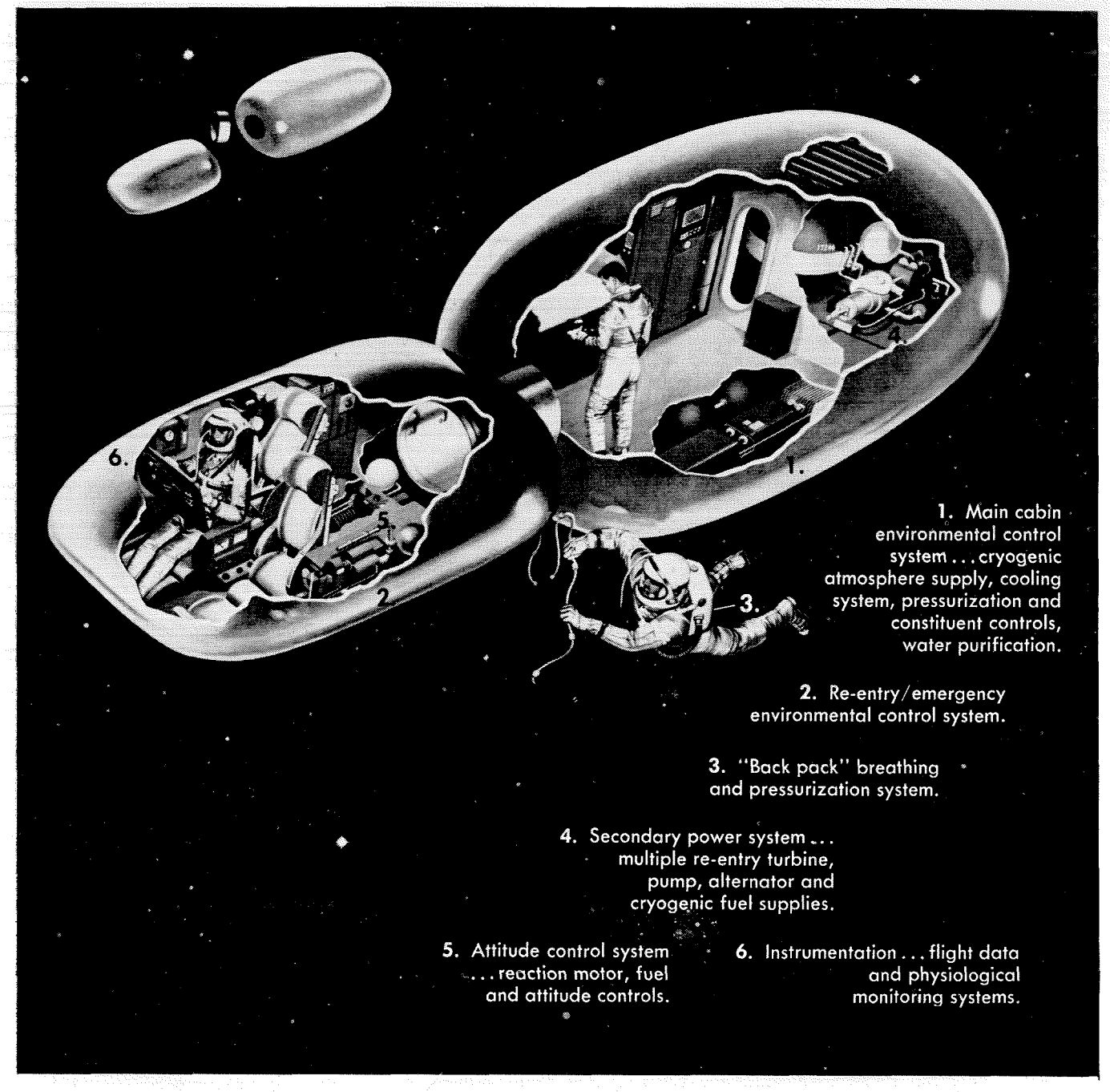
by I. L. Wiggins and J. H. Thomas '49

University of Toronto Press . . $9.50

Structural Design of Missiles and Spacecraft

by Lewis H. Abraham MS '40. Chief, Strength Section, Missiles and Space Systems Engineering, Douglas Aircraft Co.

McGraw-Hill $12.50



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ENGINEERING AND SCIENCE
March 1962, Volume XXV, No. 6

Some basic facts of strength and weakness in the free world and the Communist world — and the prospects for progress in

THE COLD WAR

by Robert L. Minckler

The central core of American interest in world affairs lies in the conflict between the free world and the Communist world. This conflict, along with other kinds of problems, shows up in the trouble areas of the world – Berlin, China, Cuba, Laos, Indonesia, the Congo, the United Nations, Latin America. Each of these is important to some degree in the cold war, but none of them will be of enough importance to be decisive.

China, for example, has an enormous population, but it is a woefully weak country. Its gross national product, the value of everything produced, is only 65 billion dollars per year compared with our current rate of $560 billion – a per capita figure of $100 in China compared with our $3000.

For the year 1959 the Chinese reported phenomenal increases in industrial and agricultural production. We know now that the reported figures were false, inspired by fear of punishment for failure to reach production quotas. For 1960 and 1961 the Chinese have reported no overall figures, but we know that their agriculture is in a terrible mess. We know that they have had to import millions of tons of food to alleviate somewhat a condition of mass starvation. We know that the monthly ration of a Shanghai housewife is 16 pounds of grain, 16 ounces of salted fish, 2.2 ounces of sugar, and 4.4 ounces of edible oil – that is all. We know that her ration of soap is one bar for six months and her ration of textiles is one-half yard of cloth for six months. We know that China's production of these necessities is less, not more, than in earlier years.

We hear no more about the rapid rise in Chinese industrial production. Instead, we hear fragmentary reports about the steel from the Chungking plant which was so poor that simple harrows made of it broke in use. We hear that the iron and cement from the much-advertised backyard furnaces and kilns have been so poor as to be total waste.

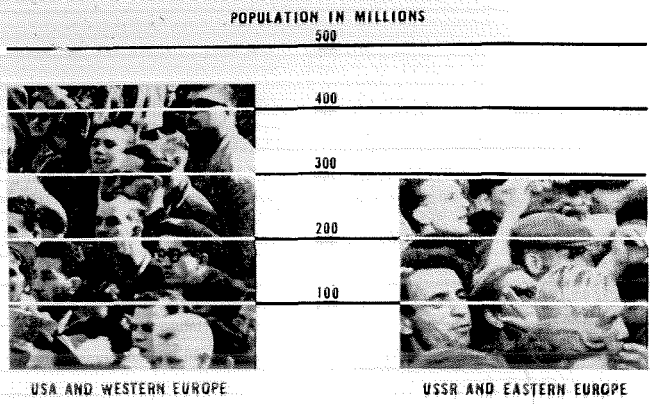
It will be a long time before anything China does will be decisive in anything.

The same is true in the so-called underdeveloped nations of Asia and Africa and Latin America. In most of these countries the picture is one of people crushed by burdens of ignorance, disease, and poverty; and governments marked by corruption, deceit, and savagery.

It is important that we resist the spread of Communist aggression and subversion among these poor peoples, but we should not delude ourselves into believing that what we do, or do not do, in Laos or Cuba or the Congo or Bolivia is going to be decisive one way or the other.

The decision is going to come in Europe and it will depend on what the United States, Western Europe, Eastern Europe, and the Soviet Union do. Let us review the basic facts of strength and weakness and the prospects for progress in these four areas.

First, population: What numbers of people are involved? The population of the United States is about



180 million, Western Europe 260 million, Eastern Europe 80 million, and the Soviet Union 215 million. These add up to 440 million for these parts of the free world and 295 million for these parts of the Communist world. Also, another important factor to consider is the doubtful loyalty of Eastern Europeans to the Communist cause. In the event of conflict, these Eastern Europeans, who have a heritage of freedom, are more likely to be a burden than a help to the Russians. Any way you look at it, the people who would be on our side far outnumber the people against us.

Second, productive capacity as measured by gross national product: The figures in 1960 were – United States $516 billion, Western Europe $312 billion, Eastern Europe $75 billion, Soviet Union $210 billion – a total for the West of $828 billion, compared with a total for the East of $285 billion; a favorable margin for the West of nearly 3 to 1.

Third, military power: What numbers of people are in the armed forces of opposing camps? And this may surprise you: for the United States 2.4 million, Western Europe 3.9 million – a total of 6.3 million; for Eastern Europe 1.5 million, Soviet Union 3.6 million – a total for the Communists of 5.1 million. Again, the questionable loyalty of the Eastern European troops arises, but regardless of that, it is a fact that the military forces of our side outnumber those opposed to us.

Another interesting comparison in the military field is that in the United States about 10 percent of our income is spent for defense; in Europe, about 5 percent; in the Soviet Union, an admitted 24 percent, but on the basis we calculate ours, about 33 percent. These ratios are important, because by deducting that part of gross national product spent for military purposes from the total, an approximate differential for living standards can be determined, and it works out at about $2600 per capita per year in the United States, $1150 in Western Europe, $650 in Russia.

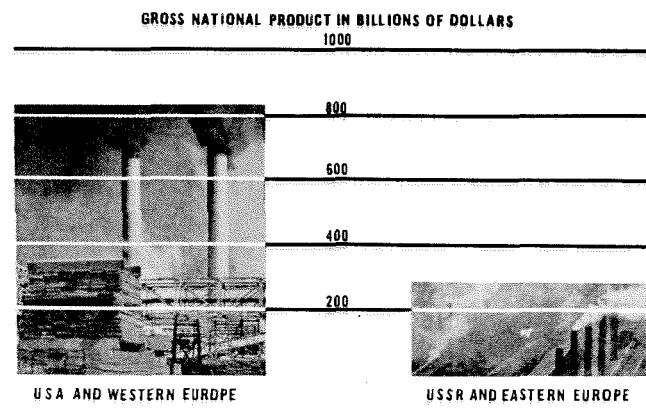
These numbers I have given you are facts; there isn't much guesswork about them. And they demonstrate the comparative great strength of the West and the comparative weakness of the East.

I have said nothing about nuclear war capacity. If the Russians had great nuclear superiority over us, these comparative numbers wouldn't mean much, because by nuclear attack they could cut our numbers and productive capacity down to their size in short order. I don't know anything about comparative nuclear war capacity, but I get some satisfaction out of the recent statement by Mr. McNamara that we have nuclear capacity of such superiority that we could absorb a surprise nuclear attack and still have the retaliatory power to destroy the Soviet Union; and also out of the reply by Soviet Defense Minister Malinovsky that this is not true – that the nuclear war capacities of both sides are about equal, and therefore the Russians want no part of a war. So long as they maintain that position, there will be no nuclear war, and the facts of comparative strength of the West and weakness of the East remain facts.

So much for the present. What about the future? Mr. Khrushchev admits Russia is behind the United States in productive capacity now, but keeps promising the Russian people that they will catch up with us in a few years. He challenges us to an economic competition and promises to "bury us," because of the superiority of the Communist system over ours. This propaganda has had an effect, and many Americans believe that the Russian economy is gaining on ours at a rapid rate.

Again, let's look at the facts – and this requires a fast look at Russian economic history. Following World War I, Russia was in terrible economic difficulties. Millions of people died of starvation, millions more worked in slave and forced labor camps. Czarist debts were repudiated and all capital possessions of the people were taken from them and nationalized. Russia was the only Communist country and lived pretty much to itself and on itself. Their foreign trade did not amount to much. Over the years very slow and very painful improvement came about, trade increased, and extremely low but tolerable living standards existed.

Then came World War II and the Soviet economic machinery was severely damaged. Immediately after the war, some part of this damage was offset by the capital goods part of the $11 billion lend-lease supplied largely by the United States; and by probably



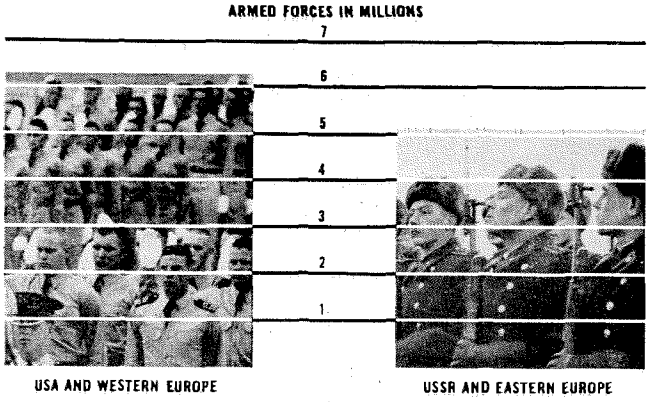
$20 billion in war booty, reparations from Manchuria, Germany, and the Eastern European satellites.

From the end of World War II to Stalin's death in 1953, Russian economic activities were largely internal – replacing war-damaged plants, mercilessly stripping the Eastern European satellites, building industrial capacity at the expense of the living standards of their people, trying to achieve maximum independence of foreign supplies within the boundaries of its enlarged empire.

There is evidence that Stalin, ever faithful to the Communist objective of world domination, believed that Western Europe would be unable to recover from the damages of the war, and that a class struggle there, egged on by subversive actions, would drop that whole area into the Communist lap. For the rest of the world, he undertook direct and indirect military aggression in Greece, Korea, Vietnam, Malaya, Burma, the Philippines, Indonesia, and China. He was successful in China, although that victory was won by the Chinese Communists without much help from the Russians. He was stalemated in Korea and Vietnam. His other military ventures were failures, and he also suffered a loss when Tito took Yugoslavia out of Moscow's control.

Stalin died in 1953, and after a time Khrushchev emerged as the new Russian leader and was immediately faced with serious domestic and foreign problems. Stalin's foreign policies, military and subversive, had not been successful. He had been wrong about Western Europe, which was prospering, and it was increasingly clear that it was not going to either collapse or go Communist. Economic conditions in the satellites, especially Hungary and East Germany, were approaching catastrophe. There were difficulties at home and intensification of activities by the secret police, who were having a hard time maintaining order.

Khrushchev inherited this condition and atmosphere of failure, and he was forced to propose a change in Soviet policy – to the principle of peaceful coexistence. Russia began active participation in international trade, economic aid to underdeveloped countries, trade fairs, cultural exchanges. Probably more important than anything else, the internal terroristic practices of the secret police were reduced, slave labor camps eliminated, and limited civil rights granted or tolerated.



And the economic conditions in Russia, based on new technology, were improving. Their new five-year plan promised still greater improvement. So the switch from Stalin's policy of military and subversive aggression to the Khrushchev economic and subversive aggression seemed quite logical.

I say "seemed," because Khrushchev evidently fell for the phony numbers game called "rate of growth," which our own left-wingers use to prove that the Russians will overwhelm us by their economic might unless we adopt the Russian methods of government planning, government control, government management, *government everything – with less and less* freedom of choice for the individual.

Rate of growth

Let's look at these numbers. Since World War II, our gross national product has increased at an annual rate of just under 3 percent, through adjustments from war to peace, recessions and booms. It is now increasing in the current boom at about 4.5 percent per year. If we could get just a little absolute increase in labor productivity, by just reducing some of the more flagrant abuses, featherbedding, unjustified strikes, jurisdictional squabbles, organizational picketing, and boycotts, I think it is reasonable to expect that our economy can grow at a 4 percent annual rate. On our 1962 base of $560 billion, that is an increase for the first year of $22.4 billion. The present seven-year-plan of the Russians calls for a 7 percent increase in national income. That, on their present base of $210 billion, is an increase for the first year of $14.7 billion. If we increase our production $22.4 billion in one year and the Russians increase their production *only $14.7 billion in one year*, how are they ever going to catch up with us, even if our rate of growth is 4 percent per year and theirs is 7 percent? It is a fact that, on a per capita basis, the Russian economy would have to grow at a rate three times ours for 20 years to catch up with us. That is an impossibility, unless we fall flat on our face.

My guess is that the Russians, unless they change their system, will not be able to maintain their planned 7 percent per year increase. This guess is based on such facts as these:

1. They have never fulfilled any of their earlier plans. The present plan was established in 1959, after the goals in the plan then operating had been proved unrealistic.

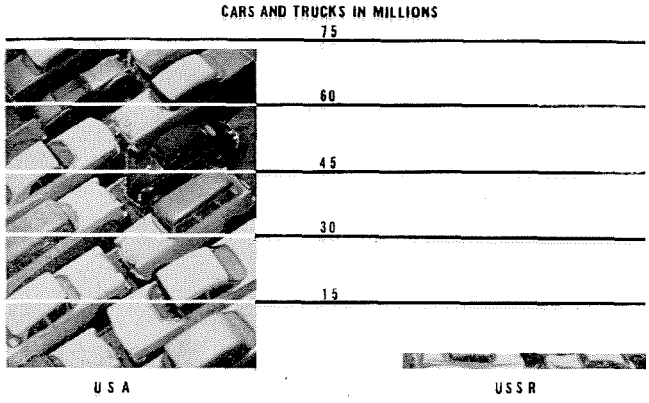
2. Let's look at their farm situation, as an example of the size of the problems they face. We have 7.4 million people in our farm labor force, who produce more farm products than we can eat or wear. The Russians have 48.3 million people in their farm labor force, and they are short of food and clothing, a situ-

ation which Khrushchev himself describes as "certain difficulties in food supplies." What are the prospects for their being able to get their farm labor effort up to something approaching ours? We are where we are because we have on our farms 4.8 million tractors against their 1.1 million, 3.1 million trucks against their 800,000, 1.1 million grain combines against their 500,000. Our farms use 26.9 billion kilowatt hours of electricity against their 8.4 billion, and 7.4 million tons of fertilizer against their 2.6 million. Russian yields are 11.4 bushels of wheat per acre compared with our 26 bushels, 7.3 bushels of soybeans against our 23.7 bushels, 82.4 cwt. potatoes against our 184.3 cwt. Khrushchev's enormous virgin lands program to bring more lands under cultivation has been a dismal failure, and most experts believe that erosion and soil exhaustion may turn it into a catastrophe of the first order. Adding up all of these facts about Russian agriculture, there is no prospect whatever that their farm efficiency will catch up to ours in the foreseeable future.

3. There will be a squeeze on Russian manpower during the 1960's because of the low birthrate in the war years of 1940 to 1946, the dates of birth of young people just now entering the labor force. There isn't anything they can do about this.

4. Their whole economic structure is top-heavy with bureaucrats. There are no absolute figures on this, but all competent observers agree that the layers of political and planning and expediting people create an almost impossible efficiency problem. There is substantial agreement by experts that the Russians spend eight times as many man-hours per ton-mile of railroad transport as we do, that overall Russian agricultural productivity is about one-sixth of ours, and that in industry the ratio is about two to one in our favor.

5. In housing, the average living space per person in Russia is 7 square meters, smaller than a 9 x 12 rug. This is the same as it was in 1917, when the Communists took over, 45 years ago. The present plan calls for an increase in 1965 to 8 square meters per person, but there isn't really much hope that this will be realized because the newly constructed buildings are falling apart. Around the new buildings on Leninski Prospect a heavy wire network is stretched at the second floor level to protect passersby from falling bricks and window sills.



6. In transportation, the Russians realized an increase of 11.2 percent in automobile production from 1959 to 1960, a truly phenomenal rate of growth. But let's look at the actual numbers. In 1960, Russia produced 139,000 automobiles, the United States 6,675,000. In January 1961, the Russian automobiles in use numbered 638,000; in the United States, the figure was 61,270,000. The entire Communist bloc of countries, including China and Eastern Europe, has about the same number of automobiles as has Sweden.

Russia has 3,300,000 trucks against our 12,050,000, and 107 tank ships compared with our 478 (which does not include 545 Panamanian and Liberian flag tankers, most of which are owned by American companies). Russia has 873 merchant ships against our 2,926, and again our number does not include American-owned ships under foreign registry.

7. One last comparison: In January 1960, Russia had 4,023,000 telephones; we had 70,597,000.

I could go on with many more comparisons like these, but I hope that I have said enough to convince you that the Russians are not going to catch up with us by 1970, or ever – if we both continue our present systems.

This is not to say that the Russians have not made a really impressive showing in rockets, missiles, and space vehicles. Of course they have, and by concentrating time and effort and money in a limited field of activity, they can make a truly successful record. Nevertheless, overall, Russia is a woefully weak nation compared with ours.

Diplomacy – an unimpressive record

The record of military and economic performance of the Soviet Union is not impressive. In diplomacy, the record of Russian performance is equally unimpressive. For example, they have given Egypt massive military aid and have undertaken the construction of the huge Aswan Dam project on the Nile. But when the usual entourage of Communist agents arrived in Egypt, they were thrown out of the country, and the Egyptian Communist leaders were put in jail. Then strict instructions were given that the Russian engineers working on the dam should have no contact with Egyptian workers and should engage in no political or social activities with the Egyptians. Approximately the same results came from heavy military and economic aid to Kassem, in Iraq.

Sekou Toure, the president of Guinea, is an avowed and dedicated Communist and first welcomed a host of Russian agents into his country. When they started normal propaganda and subversive activities in Guinea, he ordered them out of the country along with the Russian Ambassador.

In the Congo, a stream of Communist agents poured

into the country to support Mr. Lumumba's try for control. He lost out, was killed, and the Communist agents were chased out of the country. The president of the Sudan refused to let Communist planes land in that country, so that they were unable to supply Mr. Gizenga, who was the successor to Mr. Lumumba as the leader of the Communists in the Congo. Mr. Gizenga is now in the jailhouse. The record of the West in the Congo may not look too good, but certainly there has been no victory for the Communists.

In the United Nations, the Communist record is one of steady and continuous defeat. Again, we may not like some of the things the United Nations does, but the Communists have not won any clear-cut victories.

For some strange reason, we are being told that the recent conference in Uruguay was an American diplomatic defeat. At this meeting, all representatives voting unanimously except for Cuba, ousted Cuba from the Organization of American States, condemned Castro's Communism as incompatible with the principles of the inter-American system, provided machinery to report on Cuban infiltration and sabotage tactics, and declared an arms embargo on Cuba. It is true that six countries did not vote to throw Cuba out of the OAS, but they did not vote against it either. Also, the United States' hope for economic and diplomatic sanctions against Cuba was not realized. But, despite our failure to get everything we wanted, by what queer kind of thinking can results such as these be called a Communist victory?

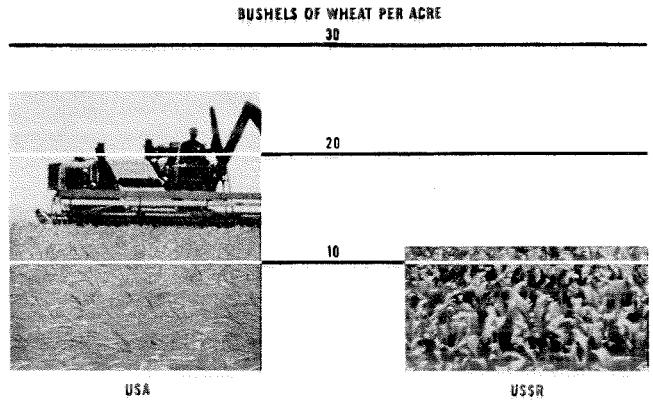
Deceit and savagery have gained a few points for the Communists. We were fooled in Cuba and perhaps in Laos; there is the Berlin wall; there is the resumption of nuclear weapon testing by the Russians while they were negotiating with us for a test ban (testing, by the way, which was the culmination of at least 18 months of preparation for testing). Hopefully, we have learned some lessons from these experiences and future entrapments of these kinds will fail.

More failures than successes

Despite these errors, the picture of a triumphant Communism marching down the road to success after success is not a correct one. They have failed more often than they have succeeded.

And now I want to talk about what is probably the most important current event in world affairs and a matter of the greatest significance in the East-West struggle – the development of the European Economic Community, the so-called Free Market area of Western Europe.

In the past, rivalries between the nations of Western Europe have brought about most of the destructive wars of modern history, but since World War II, the important nations of this part of the world have been united in the military field through NATO. This



organization has never attained the strength hoped and planned for it, and there have been numerous instances of lack of cooperation by one or more of the nations involved, but it has hung together and has been a deterrent to Soviet military aggression.

A few years ago, the idea of a free trade area was proposed and six nations on the Continent – Luxembourg, Belgium, France, West German, the Netherlands, and Italy–formed the European Economic Community with a definite program for ultimate elimination of all bars to the free movement of people, goods, money, and services between nations. At the beginning, most people thought that this was a completely crazy idea. The nations would not give up any national rights, the labor unions would never permit Italians, for example, to work in France; the German farmers would never allow their high protective tariffs to be eliminated; the French would never get along with the Germans. Nevertheless, all of these difficulties were overcome and the Common Market is becoming a tremendous success. Its future is now so secure that even the British, with their historic ties to the Commonwealth and their historic aversion to the Continent, are being forced to join the movement and are applying for membership. When Great Britain joins, so also will Norway and Denmark and Ireland. Even Sweden and Switzerland, despite their traditions of neutrality and independence, are more than toying with the idea of joining. Such unlikely candidates as Spain and Portugal are putting out some tentative feelers.

The prospective success of the Common Market has had a shattering effect on the Soviet Empire, which first ignored it (as did almost everyone else), started a study of it in 1959, published long articles about it in 1960, applied strong pressures to Austria and Finland in 1961 – warning them that their joining would be considered a violation of the neutrality positions in their treaties with Russia – and started a shift in their attitude toward West Germany. Where before, in their propaganda, West Germany was to be feared as a source of military aggression against the East, the present tendency is to dangle before the West Germans the idea that West and East Germany should get together, eliminate military spending, de-

tach themselves from NATO and the Common Market, look to the East for markets and supplies and friendships, and everything will be just dandy. All of this was in a memorandum from Moscow to Bonn just a few months ago, calling up a picture of "a unified, peace-loving, neutral Germany, with little defense expenditure and a mighty, efficient economy."

This might have been an attractive deal for the Germans five years ago, but not today. The outstanding success of the Common Market to date, and the promise of enormous progress in production and living standards, have brought about other more attractive prospects. Many competent observers believe that when the Common Market is fully operative, the pressures on East Germany, Poland, and Czechoslovakia to join will become so great that they cannot be denied. Military and political influence of the Russians is so great now that no Eastern European will openly say this, but it is no secret that many competent East Germans, Poles, and Czechs are thoroughly convinced of the validity of such a prospect. One East German says, "I expect to live to see the Common Market's frontiers in the Pinsk Marshes or beyond."

Regardless of this possible breakdown in the Soviet Empire, there will be in Western Europe a community of nearly 300 million people united militarily, economically, and politically, with a productive capacity and a standard of living far in excess of the Soviet Empire's. And then there will be two anti-Communist powers – each stronger than the Soviet Union.

All of these things must now be obvious to the realists in Russia. Perhaps this is a clue to the mysterious goings-on in the Kremlin, to the blasts against the Stalinists and anti-Party people like Molotov. Are there still powerful Stalin forces in the Communist Party? Are they pointing the finger at Khrushchev, saying: "You and your peaceful coexistence! You have failed in your plans to bury the capitalists through our superior economic strength! You should have continued Stalin's policy. You should have marched against West Germany eight years ago. At that time, we had militant and well-organized Communist parties in the West, especially in France and Italy. A little push then and we would be in control throughout Europe." Is this the kind of squabble going on in Moscow? I don't know, but it might be.

What can the Russians do?

In this present situation, what will the Russians do? What can they do? Start a war? That is a possibility, but it is probably too late, and probably they know it. They certainly can't be sure that they can win, and they certainly have never demonstrated that they are eager to take chances. It would take a tremendous effort to reconcile the Russian people to the idea of war. They have had a tiny taste of freedom now and they have been promised many things that they know a war would make impossible.

Khrushchev has provided himself with another out in his plea for total and universal disarmament. Does he or does he not mean it? If he does, is he strong enough in the Communist Party to put it over? I don't know. But, certainly, the realists in Russia know that their only hope to secure for their people the kind of prosperity we have in the United States, and which the people in Europe will have when the European Economic Community comes to full flower, is to remove from the backs of their people the frightful burden of maintaining a military force which no longer has a chance of realizing their ambition of world domination.

And the realists in Russia must know that their only hope of spreading Communism in the underdeveloped parts of the world will be to compete with the free world, and that means that they must improve their efficiency, the quality of their products, their reliability. Elimination of waste on military projects would help them do this – and a better job of meeting the needs of these backward peoples, coupled with an increased emphasis on propaganda and subversion might serve to keep their ambitions for world-wide Communism alive.

Summarizing the situation

It seems to me that a summary of the actual situation is really something like this:

1. The Soviet Union has had an outstanding success in rockets, missiles, and space vehicles. This has been accomplished only by a concentration of effort in these fields at the expense of other activities which would have done more for their people and for the progress of the world.

2. In social and economic progress, the Soviet Union is far behind both the United States and Western Europe.

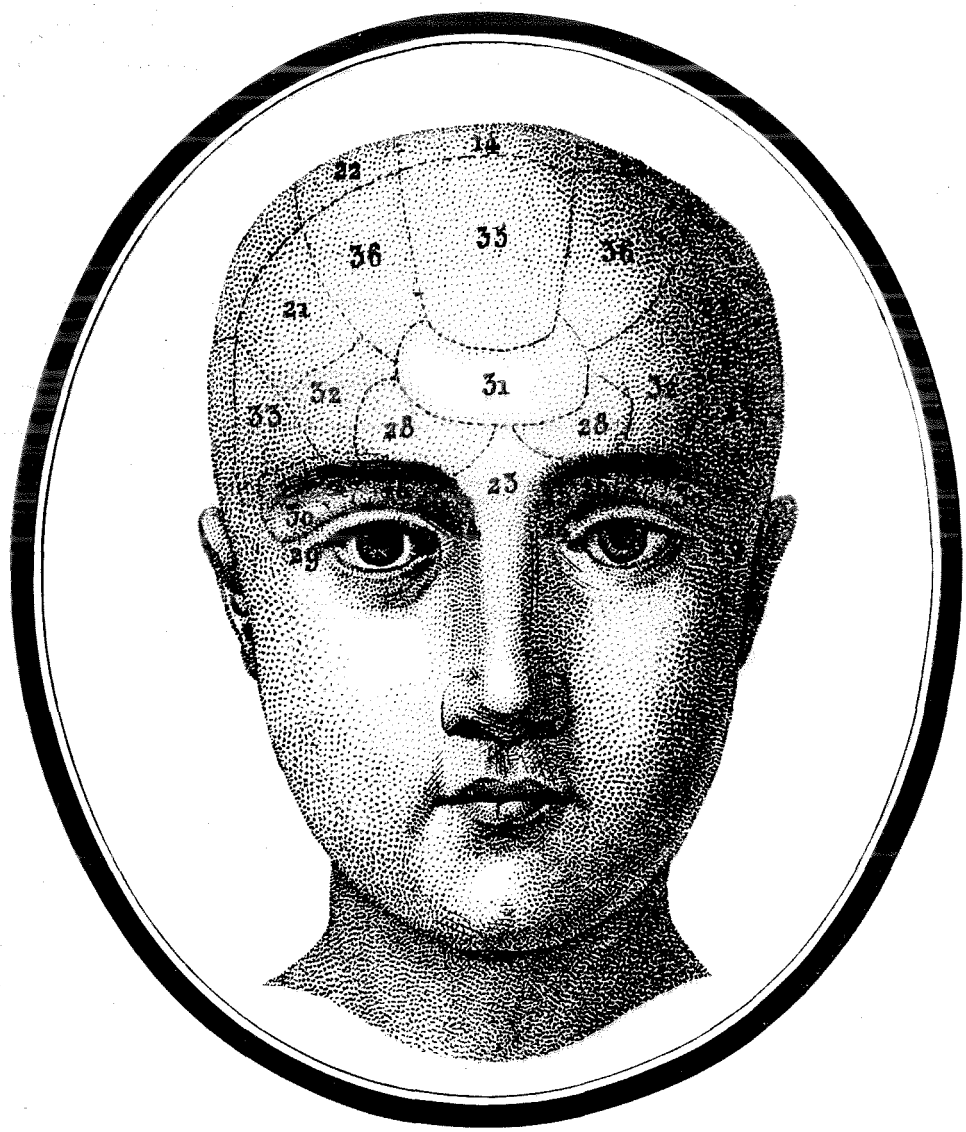
3. Living standards in the Soviet Union will not catch up with the United States or Western Europe but, on the contrary, improvements in Russia will be less than in the United States and much less than in Europe.

4. Past Russian foreign policies under both Stalin and Khrushchev have not, on the whole, been successful. They have failed many times more than they have succeeded.

5. The true situation will become increasingly clear as time goes on and will demand a change in Russian policy – not in ours.

Finally, the records show that the Russians are not all nine feet tall. They are not masterminds. Their lack of moral and ethical principles is not a strength, but a weakness. Their lying propaganda may seem effective for a time, but in the long run, the truth will prevail.

I just don't know why we should be so afraid of them.



INVESTIGATING THE BRAIN

by Theodore J. Voneida

Consider, if you will, the amount of information to which the brain is exposed at any given moment. As you read this article, for example, the light-sensitive elements in your retina are being bombarded by visual stimuli which are then transformed into electrochemical nerve impulses and carried over highly specific neural pathways to your brain. During their passage and upon their arrival at the final cell station of the visual system – the occipital cortex – they are being processed in such a way that you will be able to recall much of what you read at a later date. The details will fade with time, but even several weeks or months from now you will probably remember something about what you are reading.

Consider also what has been happening to your brain during the past hour. It has received and processed auditory impulses of various sorts, a myriad of odors, great numbers of tactile stimuli, and in all probability some tastes. In addition to these, there are the tremendous number of proprioceptive stimuli which are constantly informing the brain of your postural situation. Information entering the brain over all these sensory systems – just as was the case with vision – is subject to recall at any time. In other words, the brain has the capacity of storing in some manner a great percentage of the information it receives.

This processing and storing of sensory signals is only part of the story, for the brain is also the point of origin for most of the motor information which reaches your muscles. All animals are capable of movement, but among these man alone is capable of

Dr. Voneida gets Vincent, his favorite test subject, ready for a training session in the perceptual integration problem.

the most creative and varied types of motor activity. The ability to play the piano or the violin; to write or speak; the highly individualized facial expressions which result from slight, almost imperceptible contractions of the facial musculature – these are all unique to man, and are based on motor impulses which arise in the highly evolved cortex of the human brain.

The brain is also responsible for your ability to project into the future; you can plan your activity to the finest detail without moving a muscle. You can also reflect on the past, and mentally relive experiences which may have occurred years before.

It is not difficult to understand why so little is known of brain mechanisms when one considers the extreme complexity of this small organ which plays such a critical role in the interaction of each individual with his environment. There are numerous approaches to the study of the brain, and valuable contributions are being made from widely divergent fields of research. Techniques in neurophysiology have evolved to the point where it is possible to record electrical activity from single nerve cells deep in the awake, normally functioning brain. Methods for examining the structure of the central nervous system have been greatly refined, so that it is now possible to examine nerve cells at a molecular level with the electron microscope.

These developments have been accompanied by numerous contributions from disciplines outside the biological sciences, so that we now have a field of study devoted to the mathematical and physical bases of "artificial intelligence." The close working relationship which is developing between the biological, physical, and behavioral sciences in the study of brain mechanisms is exemplified by the Caltech conference of February 1960 on Cerebral Systems and Computer Logic. A few lecture titles from this symposium may serve to illustrate the point: "Mathematical Models of Cerebral Systems;" "Problems of the Visual Physiology and Anatomy of Amphibia;" and "Computing Principles and the Nervous System."

Numerous studies which utilize the biological approach are presently being carried out in our laboratory at Caltech. Two such studies are described here. The first involves primarily those methods which have been developed in the field of behavioral sciences, while the second is concerned more specifically with neuroanatomical techniques.

The two halves of the vertebrate brain are extremely similar, and are connected by numerous neural pathways called commissures. The largest of these, the corpus callosum, has been shown to be responsible for the transmission of highly integrated information from one hemisphere to the other. ("Brain Mechanisms in Behavior" by Roger Sperry – *E&S*, May 1957.)

Some time ago Dr. John Robinson and I became interested in the interaction of the two hemispheres in the performance of a problem involving visual perceptual integration. A training apparatus was used (above) in which cats were taught to push open the brighter of two doors in order to receive a food reward. This comparison of light intensities is a relatively simple task, and a very common one, both for cats and humans. Much of our everyday activity involves a comparison of two or more objects, followed by a choice of the one best suited to our needs at that moment. We have been attempting to investigate

the means by which this comparison is made within the central nervous system.

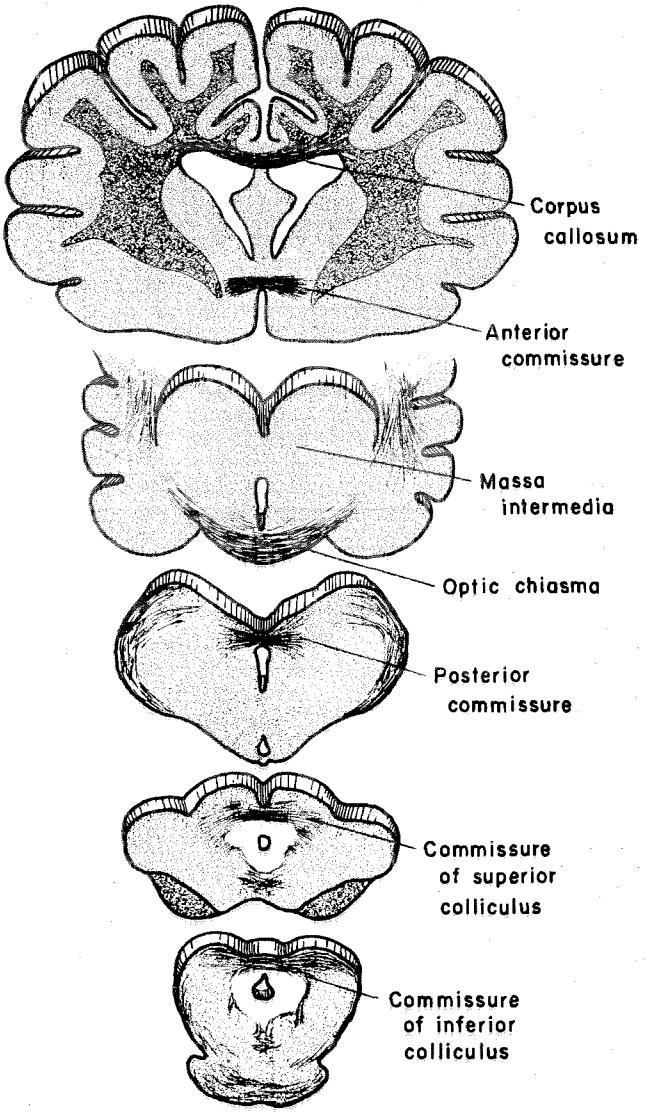
A brief look at the normal anatomy of the cat's visual system shows us that over 50 percent of the nerve fibers from one eye go to the opposite half of the brain; in other words, each hemisphere receives information from both eyes. This means that a normal animal can easily make an *intra*hemispheric comparison between two visual stimuli. What would happen now if an animal were required to make an *inter*hemispheric comparison, first with the commissures intact, then after cutting each of them in a stepwise fashion? Suppose, for example, that the crossed visual fibers were sectioned, and that one of two visual stimuli was presented to the left half of the brain, while the other was presented to the right half. In order to solve the problem, a comparison must still be made between the two, but the comparison must now be made interhemispherically.

The problem of separating the inputs

In the actual experiment, the two visual stimuli were separated by projecting one through a red filter, and the other through a blue filter. The experimental animal wore a mask with a red filter over one eye and a blue filter over the other. The two filters were chosen so that all the light passed by one was completely blocked by the other, and vice-versa. (Color played no part in the training situation – the animals were trained strictly on the basis of a brightness comparison.) Then the optic chiasm, containing the crossed visual fibers, was sectioned. This meant that all visual stimuli from one light source would now go to the right half of the brain, and all from the other would go to the left half. The first commissure to be sectioned was the large corpus callosum, which connects the two cerebral cortices. This resulted in only a very slight, transient drop in performance level.

We continued to surgically separate the two halves of the brain by sectioning each of the remaining commissural connections between the hemispheres. There was no significant loss in the ability to perform this task as long as only cortical commissures were sectioned. As soon as we began to section subcortical connections – specifically, the posterior and tectal commissures – all animals exhibited a severe fluctuation in performance. One day they would perform without making any mistakes, the next day they would perform at a chance level. Even animals with all the commissures sectioned simultaneously were able to perform at high levels of accuracy for short periods of time.

Numerous controls were run, including one animal with all the commissures sectioned, but with the crossed visual fibers intact. This animal showed no fluctuation in performance. When the optic chiasm was finally sectioned, however, the fluctuation appeared.



A diagrammatic series of transverse sections from the front of the brain to the back, showing most of the connections between the two halves of the brain.

The fluctuation in the totally sectioned cases lasted for long periods of time, but eventually – and this is perhaps highly significant – the subjects were once again able to perform consistently at high levels of accuracy. This strongly suggests that areas not normally used for this type of interhemispheric communication are now being called into play, and are indeed capable of functioning very efficiently in the absence of the "proper" cross connections. Experiments are presently being carried out to test these possibilities.

Behavioral studies are of limited use in the overall analysis of brain mechanisms unless we know something as well about the central neural connections. There is a vast anatomical literature pertaining to interhemispheric connections, but surprisingly little is known about the precise connections of the posterior commissure. The general lack of information pertaining to this commissure, plus the specific interest which arose from our behavioral study, provided the

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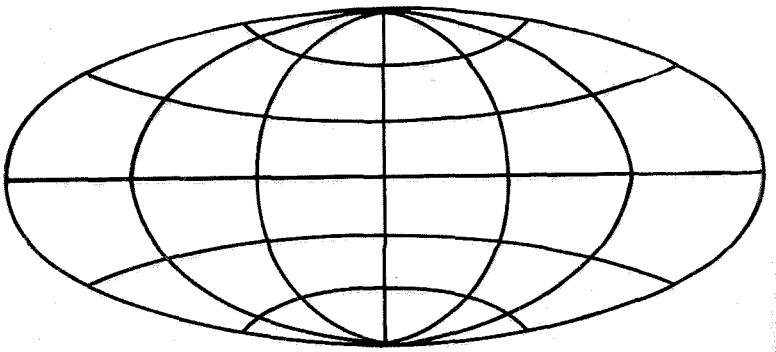


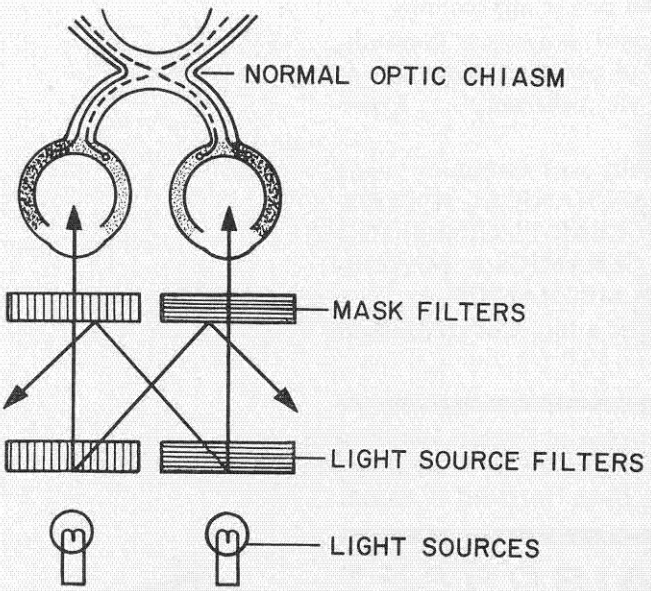
basis for an anatomical investigation of this structure.

Several techniques are available for tracing a highly specific bundle of nerve fibers lying deep in the brain. A great deal can be learned by gross dissection, but this is totally inadequate for describing its structure and location in detail. It becomes necessary to turn to microscopic techniques, all of which have certain procedures in common.

First, the tissue must be sectioned into very thin slices which vary in thickness from five to fifty microns, depending on the technique being used. Next, the tissue must be stained, so that when it is examined under the microscope it will be possible to differentiate the nerve cell bodies from the long fibrous processes called axons which extend out from them. These axons are grouped together into compact bundles called nerve tracts.

The stain which is used depends, of course, on the particular structural elements to be studied. A fiber stain, for example, is the logical choice if one wishes to examine a nerve tract or commissure which is composed of large numbers of tightly packed axons. Indeed, much has been learned about these structures from the study of normal fiber stains. Stains of this type, however, are not adequate to tell us what we need to know about the exact connections which are made by a specific bundle of fibers such as the posterior commissure. It is necessary to do something to that particular group of fibers in order to make it stand out from all the rest.

One approach is based on the fact that damaged nerve fibers will degenerate. Special staining procedures have been developed which make it possible to stain degenerated nerve fibers and nothing else. The remaining problem is that of destroying a specific group of nerve fibers deep in the brain without causing considerable damage to surrounding tissue. If the neighboring tissue is damaged, it too will degenerate, and the results will be greatly obscured. A direct surgical approach is sometimes possible, but this is often undesirable, since some damage to adjacent areas is unavoidable.



A diagrammatic representation of the training apparatus used in the study of brightness comparisons. The two sets of filters are chosen so that all visual stimuli from one light source enter the right eye, while those from the other light source enter the left eye.

Electrolytic lesions

There is a means, however, by which discrete lesions can be placed deep in the brain with a minimum of trauma to surrounding regions. This method involves the use of the Horsley-Clarke stereotaxic instrument. Its design utilizes the constancy of brain-skull relationships in adult animals of the same species. Atlases based on this instrument provide the exact horizontal, vertical and anterior-posterior coordinates for any brain structure. A small, highly localized lesion can be made with this instrument, then after a sufficient period of time is allowed for neuronal degeneration to occur, microscopic sections of the brain are stained specifically for degenerated axons. We are presently tracing some of the unknown connections of the posterior commissure by this method.

I have very briefly outlined two techniques which are presently being used in our laboratory for the study of brain mechanisms. The behavioral approach to the problem of visual perceptual integration has led us into an anatomical investigation of the subcortical interhemispheric connections.

The behavioral study has shown us that interhemispheric brightness comparisons can be made perfectly well in the absence of the crossed optic fibers, plus all the cortical connections between the two halves of the brain. Furthermore, we now know that subcortical connections such as the posterior commissure must play an important role in normal interhemispheric communications of this type. The anatomical data has given us valuable information as to the exact connections of this commissure on each side of the brain. Finally, the ability to perform this integration in the absence of all the commissures strongly suggests that structures not normally used in this capacity can be called into play if needed.

Future investigations have been planned in which the connections of these other areas will be studied, both behaviorally and anatomically. Our understanding of brain mechanisms is gradually increasing — the greatest limitation lies in the ability of the brain to understand its own function.

THE BELL TELEPHONE COMPANIES SALUTE JIM BOARDMAN

Two years ago Jim Boardman was studying engineering principles in college. Today his judgment plays a key part in the construction of microwave tower systems, which speed telephone conversations over high, rugged terrain. He is responsible for finding the right locations for essential repeater stations that amplify and relay telephone conversations through a microwave system.

Jim Boardman of Mountain States Telephone & Telegraph Company, and other young engineers like him in Bell Telephone Companies throughout the country, help bring the finest communications service in the world to the homes and businesses of a growing America.

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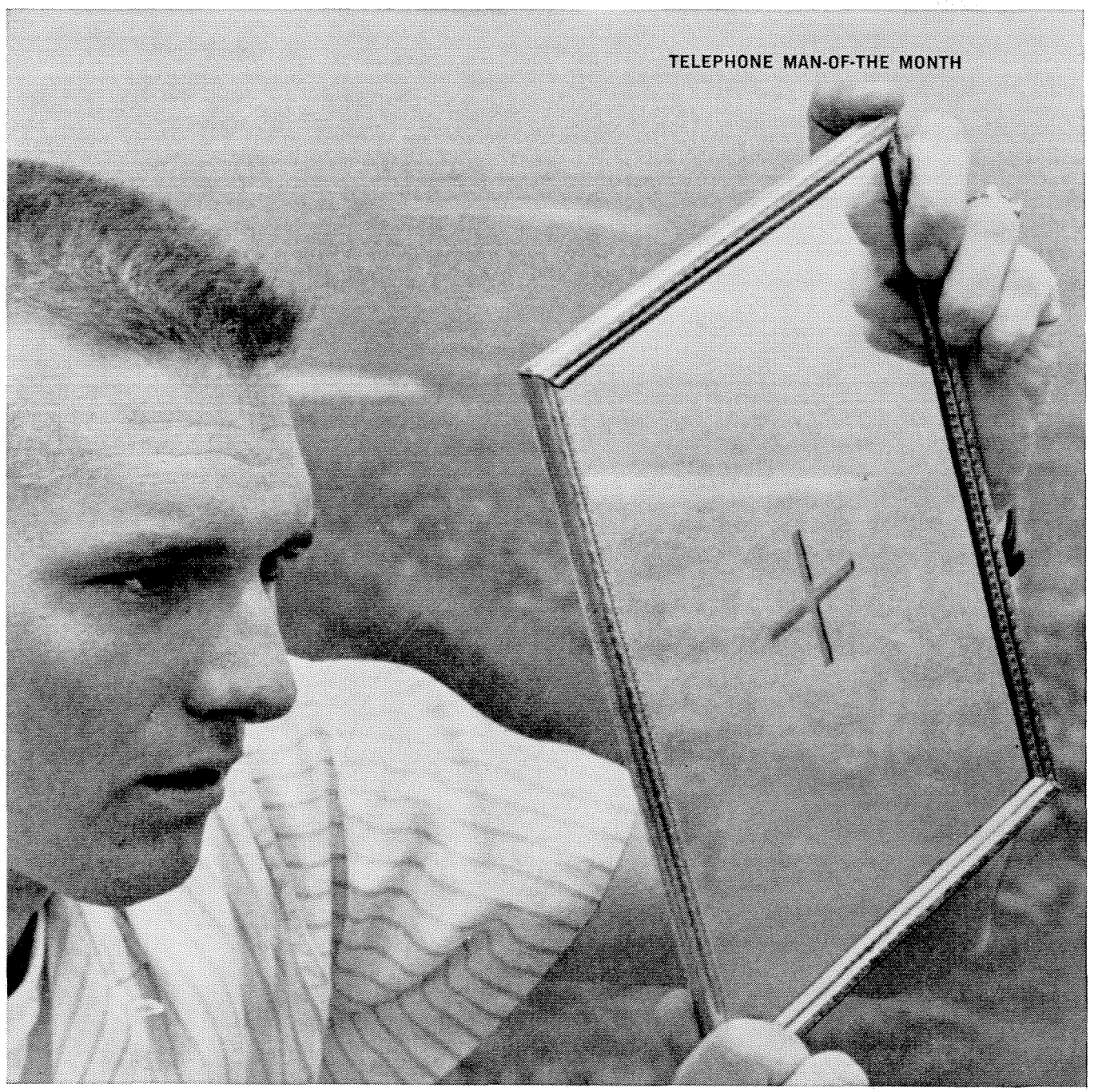


The Month at Caltech

Leaders of America

The Rt. Rev. James Pike, Bishop of the Diocese of California of the Protestant Episcopal Church, visited the Caltech campus from February 13-15 as the first guest in this year's Leaders of America program, sponsored by the Caltech YMCA.

During his visit, the Bishop's talks included "Radical Left, Radical Right, Radical Center," "Family Planning," "The Future of Civilization," and "Religion, Science, and Technology."

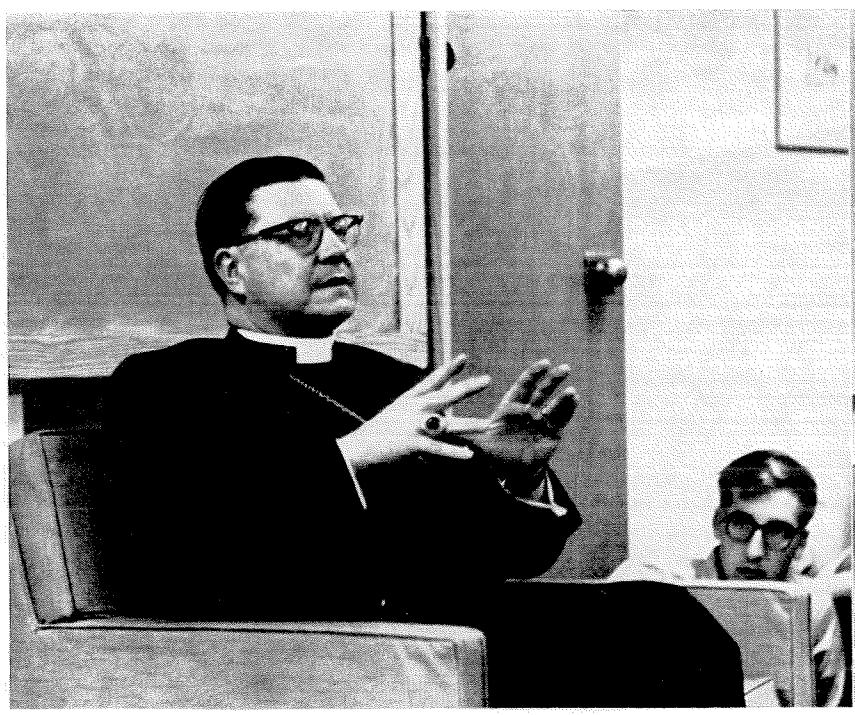
The next guest on this program will be Sydney Hook, chairman of the graduate division of philosophy at NYU, who will be here from April 11-13. Also, two of the three Leaders who will be here in 1962-63 have now been confirmed: Barry Goldwater, U.S. Senator from Arizona, for November 1962; and David Riesman, author of *The Lonely Crowd*, in May 1963.

JPL's Space Simulator

Caltech's Jet Propulsion Laboratory has just completed a 4-million-dollar space simulator which will be used to determine the ultimate design of lunar and planetary spacecraft that JPL is developing for the National Aeronautics and Space Administration.

The first spacecraft to be tested in the simulator is the Mariner, a 450-pound Venus probe. The Mariner is 10 feet high and measures 14½ feet across with its

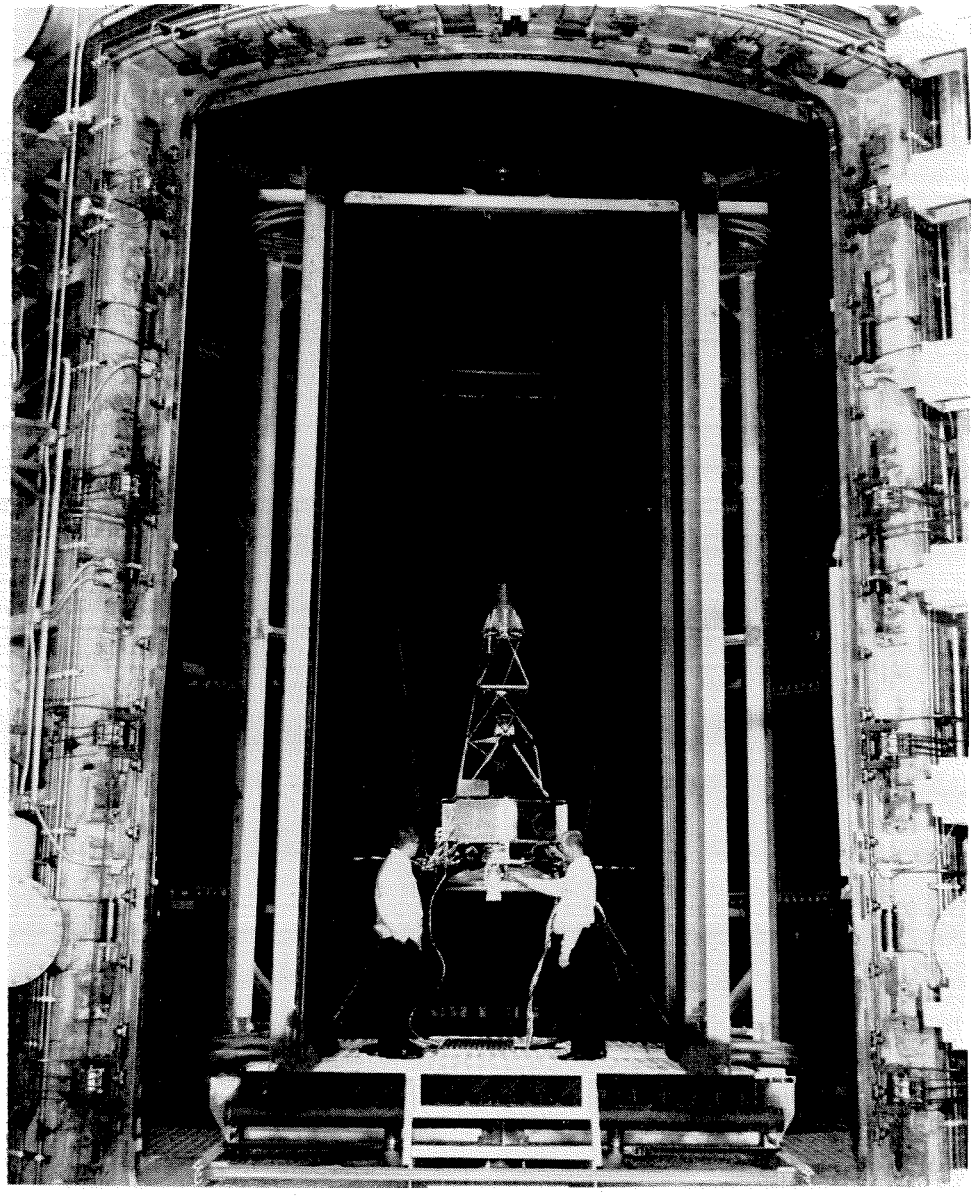
continued on page 28



In an informal discussion with Caltech students . . .

Bishop Pike makes a point . . .

JPL's new space simulator starts its first tests — on a Mariner temperature-control model. Here, technicians are making a last minute check before a giant door closes the model inside a vacuum for rigorous testing.



elaborates on it . . .

and appreciates the result as much as anyone.

If it isn't fun, don't do it!

There are those who will tell you that the world beyond the academic walls is (a) highly competitive, (b) full of opportunity, and (c) above all, serious business. Although we are keenly aware of the serious implications of the advanced propulsion work we're doing, at UTC we take a somewhat different view.

We believe that the right man in the right job will *enjoy* what he's doing. He'll find the competition stimulating, the challenge exciting. He'll be eager to get to work in the morning, simply because his work is *fun*. And this enthusiasm is bound to rub off on the paycheck, make no mistake about that.

Now, while you're giving serious thought to your future, we invite you to check out the possibilities here at UTC. For more information, write Jay Waste, Dept. 11.

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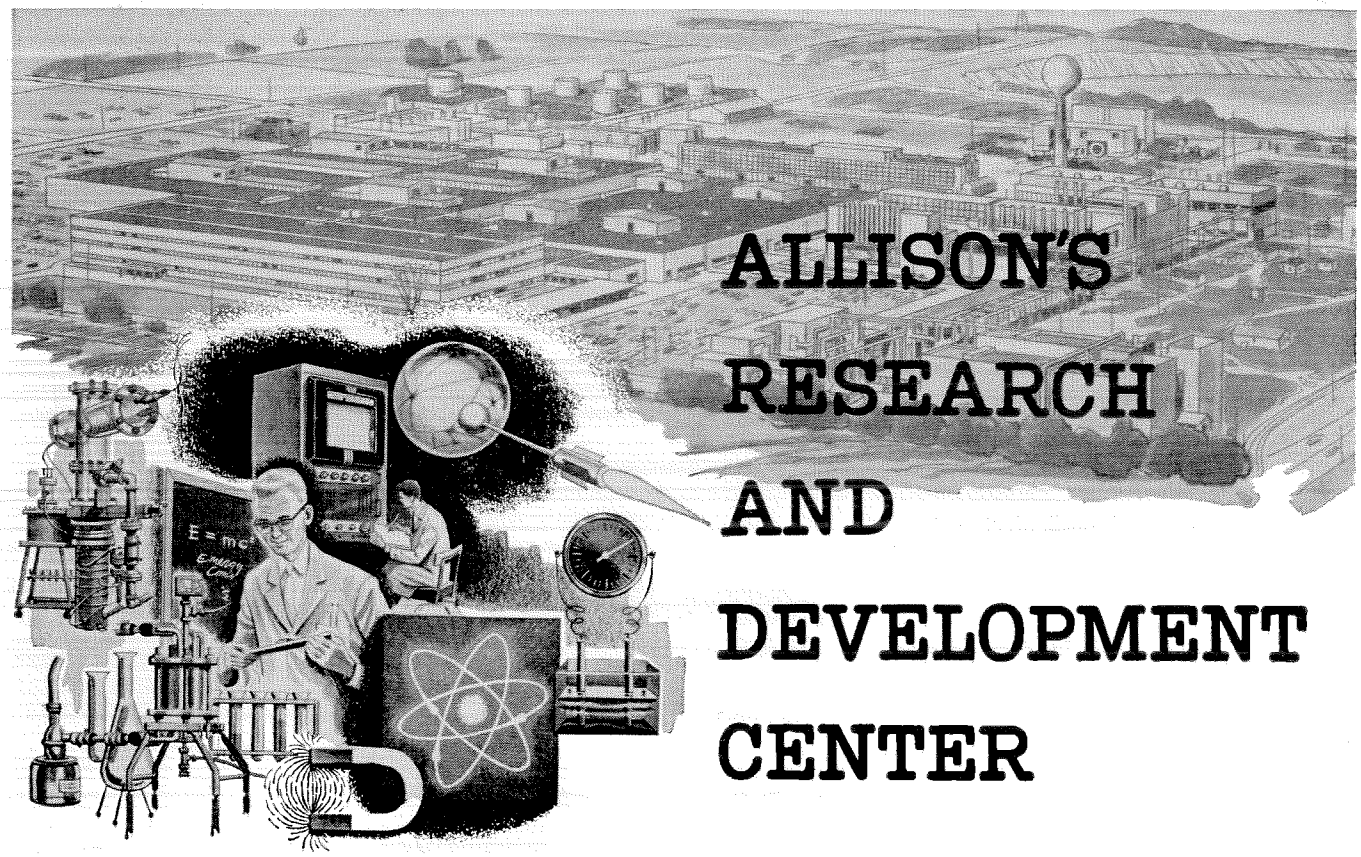

ALLISON'S RESEARCH AND DEVELOPMENT CENTER

● This vast, 217-acre complex of test cells and modern laboratories is the Allison Division, Research and Development Center in Indianapolis.

Here, Allison scientists and engineers are pursuing numerous challenging and exciting research projects involving power and propulsion systems of the next generation.

Facilities at Allison's R&D Center include a high altitude chamber capable of simulating altitudes up to nearly 200 miles. Presently the chamber is a prime data source for studies relating to magnetofluiddynamics and the environmental simulation of space radiators.

Allison's Rocket Propulsion Facility includes laboratories for rocket motor and nozzle testing. An 18 x 64-foot rocket propulsion chamber is capable of testing up to 1000 pounds of either solid or liquid propellant at 25,000 pounds thrust.

Rocket propulsion nozzles can be tested over a thrust range of 100 to 25,000 pounds in the nozzle test facility. In the nearby combustion laboratory, engineers can study the internal characteristics of gas turbine nozzles. Here compressed air can be supplied at pressures up to 270 psia, with exhaust pressures simulating altitudes from sea level to 75,000 feet—an available pressure ratio of more than 500 to one.

Latest addition to this phase of our research program is the solid fuel rocket static test firing pad in a remote section of the R&D Center. Designed and built by Allison to accommodate rocket thrusts up to 12,750 pounds, this new facility is being used for evaluation and perfection of such current projects as space vehicle and attitude control systems, and advanced rocket nozzles. Provisions are incorporated to apply varying degrees of yaw, pitch and roll—conditions that are corrected by the attitude control system to demonstrate its ability to keep a missile or space vehicle on its programmed course.

Of course, these are only a few of the facilities and research projects at Allison. There's a laboratory for virtually any requirement—physical optics, radio-isotope, infra-red, solid state physics, physical chemistry, direct conversion, heat transfer, fluid dynamics, to name a few.

And the story doesn't end here. The Allison Scientific Advisory Board, American and European consultants, and the vast resources of the entire General Motors organization also support Allison's efforts.

These extensive facilities plus research work underway and nearly half a century of experience in energy conversion represent the capabilities which Allison is harnessing in its contribution to the aerospace needs of the future.

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solar panels extended. The space environment simulator is large enough to test the complete spacecraft in its flight configuration. It has a lighting system that duplicates all the visible and invisible rays of the sun in a parallel beam. It comes as close to the perfect vacuum of space as possible, and it is designed so that the inner walls do not emit heat, and absorb heat and light radiated by the spacecraft.

The entire simulator facility, largest of its kind in the United States, consists of a 10,000-square-foot building to house offices, a control room, an equipment area, and the space simulator. The simulator is a cylindrical tower 80 feet high and 27 feet in diameter. In the lower part of the structure is a stainless steel vacuum chamber that measures 47 feet high by 25 feet in diameter – the area which holds the spacecraft. The upper part of the tower contains a solar simulation unit which is designed to simulate the varying intensity of sunlight that a spacecraft might be expected to encounter as near to the sun as Venus or as far away as Mars.

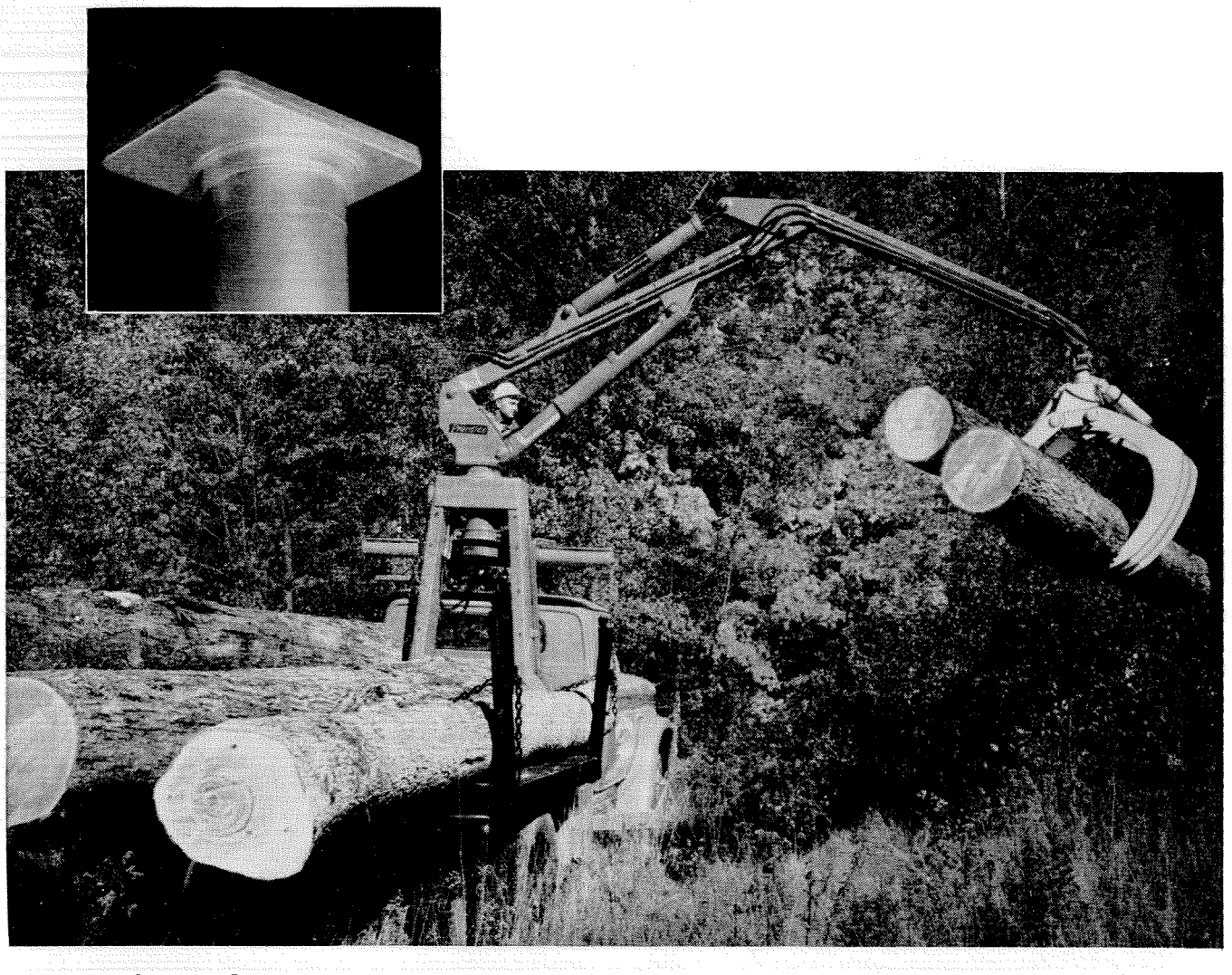
During a test in the simulator, engineers in the control room monitor the reactions to the space environment of the spacecraft's transmitting and receiving equipment, guidance and control system, and scientific instruments. This is accomplished with electrical circuits which are attached to the spacecraft and lead into the control room.

An optional unit will be added later which will simulate vibrations that a spacecraft would encounter during mid-course maneuvers or when retro-rockets fire.

Before the spacecraft is assembled and tested in the simulator, all of the component parts are subjected to individual tests in another new laboratory for their reactions to vibration such as rocket takeoff, pressures, heat, light, the vacuum of space, and other conditions which might be anticipated in space.

Many of the features incorporated in the new simulator have been developed from experience in using a small simulator which JPL has had in operation for the past 18 months.

A temperature-control model of the Mariner spacecraft is now being tested in the simulator. The Mariner itself, the unmanned spacecraft designed for a three-month bypass exploration of the planet Venus, will soon enter the chamber for many weeks of testing before the actual launching.



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FORGED

STUDENT GOVERNMENT — on the way out?

As the second term draws to a close, things seem to be going on as usual with Caltech students. But having just seen the structure of Caltech student government shaken by recent turns of events, some interested observers are beginning to think that ASCIT ought to be preparing for the possibility of a mortal blow, and that the nature of student life is currently undergoing some far-reaching changes.

For the first time that any undergraduate can recall, the campus newspaper, the *California Tech*, was threatened with demise, which would have resulted from its not having an editor. At the same time, only three of eleven other elective offices were even contested in the recent campus-wide elections. Important offices such as ASCIT Vice President, Secretary and Treasurer, and Secretary of the Board of Control were uncontested. A total of fifteen people ran for twelve offices!

With the aid of last-minute signups and a group of seniors who agreed to assume responsibility for the newspaper until an underclassman could be appointed, ASCIT squeezed through some rather unenergetic elections and so has another chance. But Caltech student government will not make a go of it without some changes in student orientation.

Critics of ASCIT who hit it for being ineffective and unnecessary miss the point. In general, Caltech can boast of one of the most unhampered student governments anywhere. Students are allowed to set up and run their own governments. The student houses have their own officers and their own judiciary groups. ASCIT is free to conduct business as it wishes, without the need for administrative approval. The newspaper is completely uncensored. Even so, this is not a drastic thing for the administration to allow, for Caltech students have conducted themselves with good judgment in the past. The result is that many offices available to those who are interested offer almost unbounded opportunities for instituting programs of great interest and worth. And these possibilities are about to be increased with construction of the Winnett Student Center, scheduled for completion in just a few months.

The Student Center comes near the end of a long development program, which – among other things – resulted in three new student houses for undergraduates. It would appear that a good place to look for changes in student attitudes which seem to go back a few years would be in changes brought about by these new houses.

In their first year of existence, the new houses were populated by a combination of people who transferred from the old houses, and those people for whom there had never been room in the houses before (the bulk of the members of Throop Club). Because of the unavoidable turmoil which was to accompany organization of the new houses, it was decided to bypass rotation – that method whereby freshmen and upperclassmen make an attempt to match interests and to exert control over freshman house assignments. Therefore freshmen were assigned to houses in an arbitrary fashion. Later that year (1960-1961) the Interhouse Committee (composed of seven house presidents) recommended rotation for the next year, but a faculty committee vetoed it, ostensibly to prolong its reinstitution until such a time as all those who had taken part in it before (including the Class of 1963) were gone.

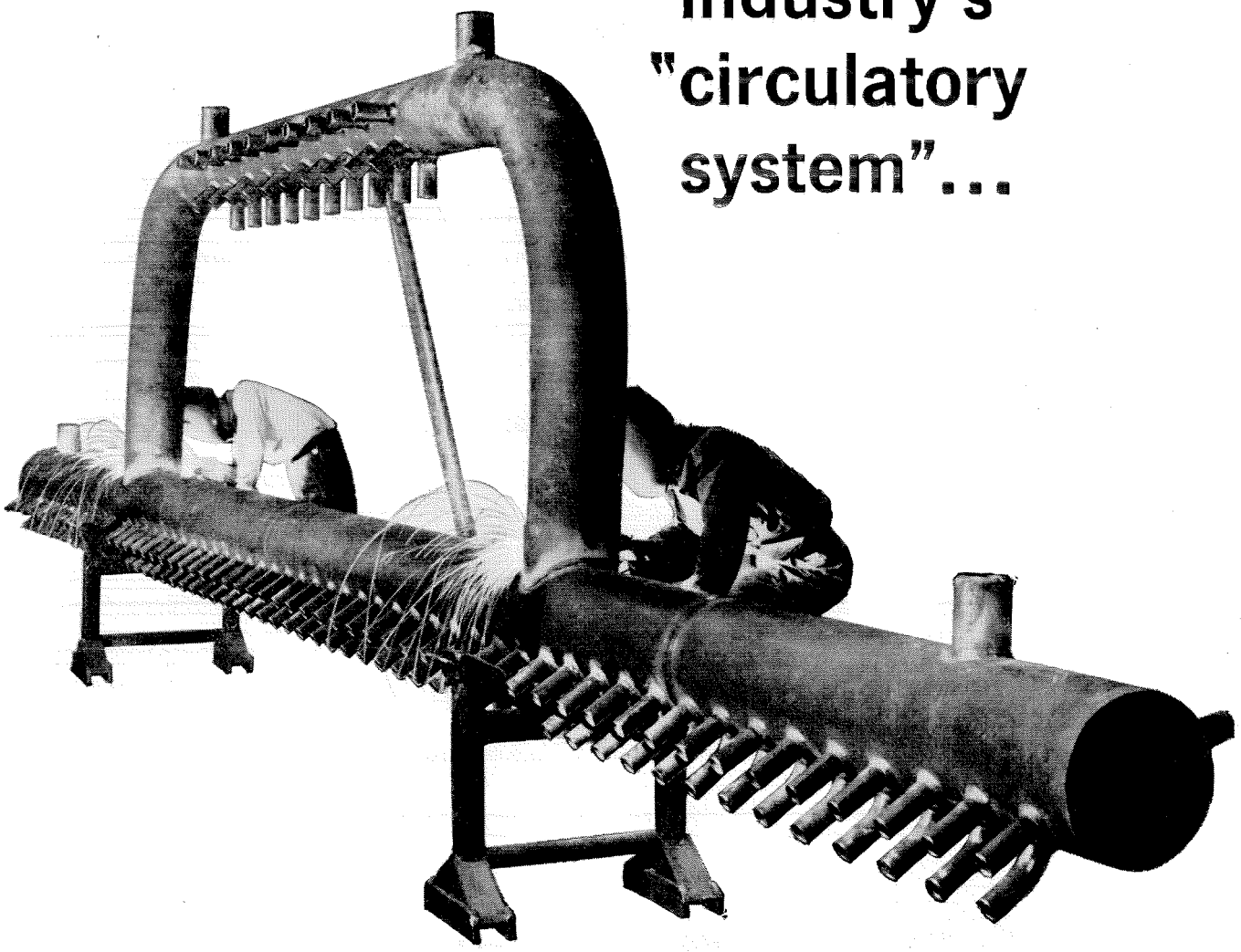
The decision stemmed from complaints that rotation had been deteriorating in the last few years to the level of fraternity rushing, and that a fresh start would improve it. That meant that if rotation were ever to be revived, it could not be until October of 1963 at the earliest.

If rotation offered no more than a congenial way to assign freshmen to houses, it would be no great hardship to go a few years without it.

But with its omission we have found that rotation had a greater effect on student life than supposed. Where several years ago there was a flourishing student government, today it's hard to drum up even enough interest to get people to run for office. Rotation, if nothing more, *forced* student interest in interhouse activities; as a result, both inter- and intrahouse activities seemed worthwhile.

continued on page 32

building industry's "circulatory system"...



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Admittedly, student governments are not beneficial *per se.* On other campuses throughout the country individual and group concern for and interest in nuclear war, disarmament, civil rights, the UN, or politics have replaced interest in student government. Fine! That is really one of the goals of student government and is a good end result of the process. But at Caltech, interest in student government has been replaced by a cultural void. It seems that, unlike other campuses, we are heading backwards in our development.

There have been many complaints about practices of rotation – it takes too much time for everyone, it bothers freshmen at a time when they are heavily beset by problems of adjustment to Caltech, there is generally too much pressure exerted on everyone by everyone, and so on. Much of this is valid criticism, but it is viewed with perhaps more alarm than the situation justifies.

Something is needed to take the place of rotation; the vacuum which now exists is leading towards ingrowth of the students because there is no strong group (with the exception of the YMCA – and it can't function efficiently on an apathetic campus) to spark interest in the vital unconventional or unscientific aspects of education.

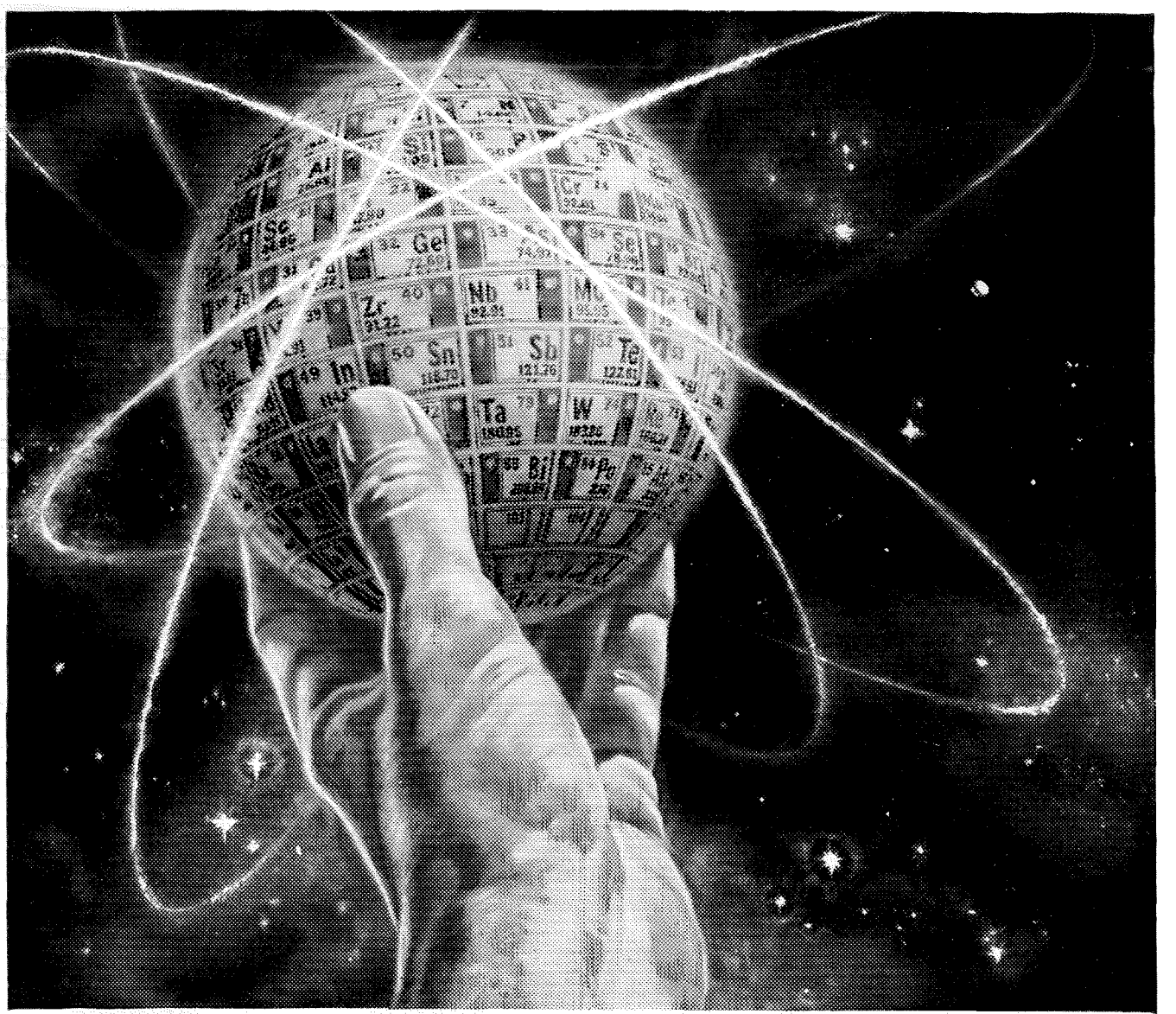
And what shall take the place of rotation? Undoubtedly, plans of action could be submitted and tried. After several years of experimentation something might be found to make the students feel they were part of an alive campus. But would it be any better than rotation? And what about the years of trial – what happens to liberal education for the students who pass through in the period of flux?

The deterioration of ASCIT in two years has demonstrated that something must be done now. Naturally, there is no unique solution to any problem of this sort, but reinstitution of a system of rotation next year might be a good start towards breaking down the unreasonable and unnecessary barriers which now exist.

True, rotation works by forcing an interest in the campus. But the interest becomes genuine and somewhat self-sustaining soon after, when the benefits and fun of large-scale activities become evident.

Next year Caltech will be presented with a golden opportunity to change things – Winnett Student Center. It would seem that rotation would be a good thing to couple with these facilities to get the ball rolling.

– Bruce Abell '62



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Periodic Chart ©Welch—Chicago

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Alumni News

Board Nominations

The Board of Directors of the Alumni Association met as a Nominating Committee on February 27, 1962, in accordance with Section 5.01 of the By-Laws. Five vacancies will occur on the Board at the end of the fiscal year (June 1962) – one vacancy to be filled from the present Board, and four members to be elected by the Association. The present members of the Board and their retirement years are:

Holley B. Dickinson '36	1962	Claude B. Nolte '37	1962
John D. Gee '53	1962	William H. Saylor '32	1963
William L. Holladay '24	1962	Peter V. H. Serrell '36	1963
Howard B. Lewis, Jr. '48	1962	William H. Simons '49	1963
Charles P. Strickland '43	1963		

The following nominations have been made:

President – William L. Holladay '24	(1 year)
Vice-President – Peter V. H. Serrell '36	(1 year)
Secretary – Donald S. Clark '29	(1 year)
Treasurer – John R. Fee '51	(1 year)
Director – Robert O. Boykin '34	(2 years)
Director – Patrick J. Fazio '53	(2 years)
Director – G. Russell Nance '36	(2 years)
Director – Richard W. Powell '40	(2 years)

Section 5.01 of the By-Laws provides that the membership may make additional nominations for the four (4) Directors by petition signed by at least twenty-five (25) members in good standing, provided the petition is received by the Secretary not later than April 15. In accordance with Section 5.02 of the By-Laws, if further nominations are not received by April 15, the Secretary casts a unanimous ballot for the members nominated by the Board. Otherwise a letter ballot is required.

Statements about the nominees are presented below.

– Donald S. Clark, Secretary

ROBERT BOYKIN received his BS in mechanical engineering in 1934. He worked for seven years as a petroleum engineer for the Barnsdall Oil Company, then came back to Caltech for two years as a mechanical engineer on wartime rocket work. He then joined the Fullerton Oil Company, and in 1948 became manager of gasoline plants. He continued this work for 14 years for Fullerton and its successor, the Monterey Oil Company, until Monterey's holdings were acquired by the Humble Oil and Refining Company. He is now a petroleum engineer with Humble, and was recently elected president of the California Natural Gasoline Association.

PATRICK J. FAZIO received his BS in geological sciences in 1953 and then spent three years as an exploitation engineer for the Shell Oil Company. In 1956 he joined the McCulloch Oil Corporation of California and is now vice president, exploration and operations manager, and a member of the board of directors. At McCulloch he is responsible for all activities relating to exploration drilling, production development, and remedial work. At Caltech, he played frosh and varsity football, and was co-captain during his senior year. He was second representative during his sophomore year, vice president during his senior year, and served on the Board of Control.

G. RUSSELL NANCE received his BS in mechanical engineering in 1936. From 1936 until 1940 he was in the engineering department of The Fluor Corporation. He then joined the U.S. Rubber Company for a year, working in their mechanical sales division. He served in the U. S. Naval Reserve from 1941 to 1945, then formed the G. R. Nance Company in Los Angeles, which handles sales of engineering equipment to the petroleum refining industry. He has also been active as an independent oil operator.

RICHARD W. POWELL received his BS in engineering in 1940, and his MS in electrical engineering in 1947. He then spent eight years as a research engineer with the Lockheed Aircraft Corporation, three years with G. M. Giannini & Co. as chief development engineer, and ten years with the Aerojet-General Corporation, ending his term with them as manager of the avionics division, with responsibility for advanced design, research, development, and pilot production of infrared systems. In 1960 he joined the Telecomputing Corporation as vice president and general manager of the electronic systems division.

THE CALTECH ALUMNI ASSOCIATION

Announces

THE 1962 DINNER DANCE

Saturday, March 24, 1962

At the

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COCKTAILS IN THE LOS ANGELES ROOM AT 6:30 p.m.

DINNER IN THE GOLDEN STATE ROOM AT 7:30 p.m.

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For Combination Dinner and Dance – $7.00 per person

(includes dinner, dance, tip, and taxes)

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Attention: Dr. John B. Opfell

Personals

1932

James D. Cobine, MS, PhD '34, physicist in the General Electric Research Laboratory in Schenectady, N.Y., has just been granted four U.S. patents covering key inventions in the area of vacuum switches — specifically, on electrical contacts, vacuum switch electrode materials, and vacuum switch design. This brings Jim's patent total up to 15.

1936

Louis G. Dunn, MS '37 ME, MS '38 AE, PhD '40, president of Space Technology Laboratories since 1958, has been elected to succeed General J. H. Doolittle (retiring) as chairman of the board of STL. In 1954 he joined STL's predecessor organization, The Ramo-Wooldridge Corporation Guided Missile Research Division, as vice president and division director. He became executive vice president and general manager of STL in 1957, and upon STL's incorporation as a subsidiary of Thompson Ramo Wooldridge in 1958, was elected president and a member of the board of directors.

1943

George T. Felbeck, retired officer of the Union Carbide Olefins Company, and his wife, were killed in a plane crash at Idlewild Airport in New York on March 1. George had been with Union Carbide since 1923, and his most recent position was as vice president of the research division of the Olefins Company. He had retired just last month. The Felbecks are survived by three sons — George, Jr., of Newark, Del.; David K. of Ann Arbor, Mich.; Richard B. of Wernersville, Pa.; and one daughter, Mrs. Karen Canaday of Whyalla, South Australia.

Leonard S. Alpert is now manager of the Operating Department of the Shell Chemical Company in Houston. He has been with the company since 1947. The Alperts have three daughters: Elizabeth, 11; Emily, 9; and Evelyn, 7.

1945

Walter W. Garvin, MS, PhD '48, died of a heart attack on January 11 in San Mateo, Calif. He was senior staff mathematician in the Electronic Computer Center of the Standard Oil Company of California. From 1948 to 1959 he worked for the California Research Corporation. As senior research physicist for that company, in 1952, he carried on

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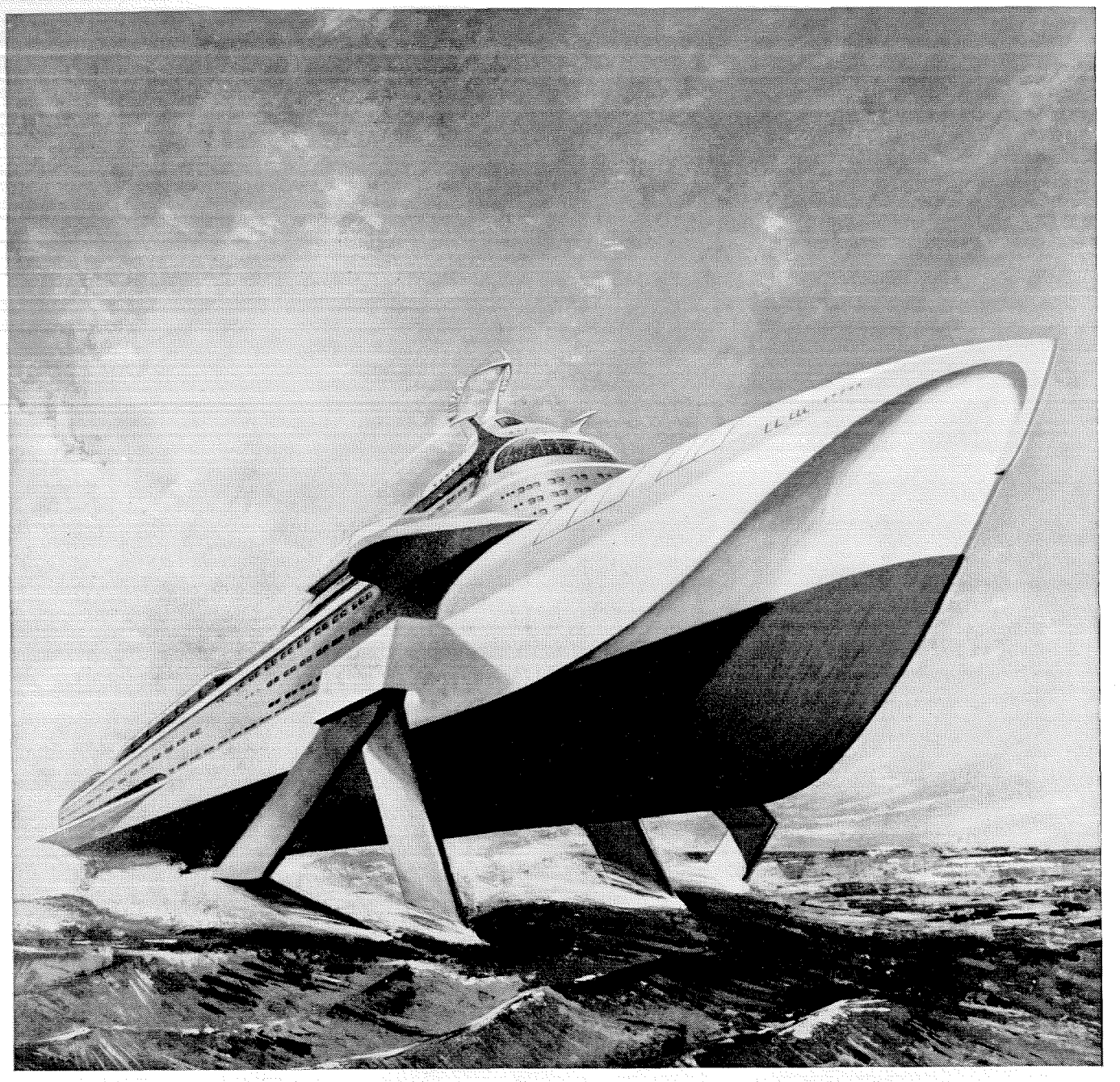

Hydrofoil ships...another engineering challenge!

Such a revolutionary concept in sea-going design represents still another major challenge for today's engineers. Through their careful and creative planning, this hydrofoil ship will move from the drawing board to reality. One such vessel, now under development, is planned to travel 100 miles an hour. It will skim over the tops of waves like a flying fish, lifted aloft by a set of underwater wings.

Through the intensive research of the metallurgical engineer will come a metal for these hydrofoils, strong and tough enough to stand up to difficult underwater service. A metal which will resist corrosive attack by the coursing brine, cavitation from the seething turbulence, stresses and strains from the load of the ship.

An engineering career, such as metallurgy, is full of challenges. Exciting new designs – gas-turbined cars, nuclear-powered ships, monorail transit systems–all will be in your range of exploration, affording you a great opportunity for advancement in a profession that promotes progress and economic growth.

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fundamental research in theoretical physics in support of Standard Oil Company of California's expanding program in this field. This research resulted in important contributions to the knowledge of earth structure and stratigraphy, and to the understanding of geophysical processes. In 1954 he was appointed research associate, and in 1956, senior research associate. He became senior staff mathematician for Standard Oil in 1959.

Walter is survived by his wife and two children: Walter William, Jr., and Kelsey Anne.

Robert F. Schmoker has been transferred by American-Standard Industrial Division from Sacramento to the general offices in Detroit. He is now product manager for school air conditioning systems. The Schmokers have three children—Linda, 15; Nancy, 8; and Bobby, 6.

1948

Dr. Griffith C. Barlow of Glendale has been named president-elect of the general practice section of the Los Angeles County Medical Association. He will become president in 1963. Dr. Barlow is also a California registered mechanical engineer and from 1937 to 1948 was a project tool engineer at Lockheed. After receiving his BS from Caltech in biology he attended the USC School of Medicine. He began private practice in Glendale in 1954. His professional associate is Dr. Mary Jane Barlow, his wife, and they are parents of four children – Nancy and Steven in elementary school; Donald, a pre-medical student; and Mrs. Linda Rittenhouse of Arcadia.

1954

Neal Huntley, MS '55, has been transferred to Tampa, Florida, as plant manager of the Clorox Company's Tampa plant. The Huntleys had a second son on January 16.

1955

Thomas Noonan, PhD '61, now has a temporary job at the Smithsonian Astrophysical Observatory in Cambridge, Mass. doing theoretical research in physics. "I have the distinction," Tom writes, "of having spent ten consecutive, enjoyable years as a student at CIT."

CALTECH VARSITY GAME SCORES

BASKETBALL

February 2	La Verne	66	Caltech	72
February 6	Whittier	79	Caltech	53
February 9	Redlands	69	Caltech	47
February 10	UC Riverside	78	Caltech	58
February 13	Occidental	83	Caltech	59
February 16	Pomona	78	Caltech	55
February 20	La Verne	83	Caltech	53
February 23	Claremont-H. Mudd	54	Caltech	45

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The location of the informal weekly alumni luncheon, which is held on Thursdays at 11:45, has been changed to the 13th floor of the Engineers Club, 206 Sansome Street, San Francisco; Mr. H. Farrar, EX 9-5277, can be contacted for reservations on Thursday mornings.

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Meetings: University Club, 1319 "K" Street
Luncheon first Friday of each month
Visiting alumni cordially invited—no reservations

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Program Chairman — Herman S. Englander, '39
U. S. Navy Electronics Laboratory

Kodak beyond the snapshot...

(random notes)

Deep in lacquer

That our name is never seen on a can of lacquer doesn't mean we aren't in it pretty deep.

Our newest cellulose ester for the lacquer formulators has the butyrylated, acetylated cellulose chains running much shorter than heretofore. This results in higher solubility, which means less solvent needed. It also means poorer film strength, but that's OK. A butylated urea-formaldehyde resin, included at the right proportions in the formulation along with the proper catalyst, will cross-link to the cellulose acetate butyrate during the drying of the coating. To provide a point of attachment on the cellulose chain, we restore one out of 12 of its hydroxyls. This condenses with the butoxy groups of the butylated urea-formaldehyde polymer to split out butyl alcohol.

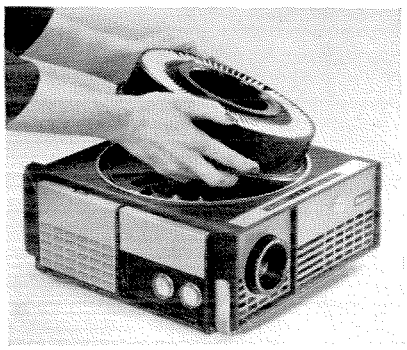
Thus the short chains that are more soluble in the can become very much less soluble in the finish of a table on which some gay dog has set down the cup that cheers. No longer need a drop of lotion spilled on the dresser trouble the conscience of a good woman.

In these days of epoxies, silicones, methacrylates, polyesters, etc., why do we monkey with cellulose? What a silly question!

For one thing, we have shown how admixture of cellulose acetate butyrate can improve them all.

For another, cellulose is by far the world's most abundant high polymer. It is formed by sunshine.

The happy eye



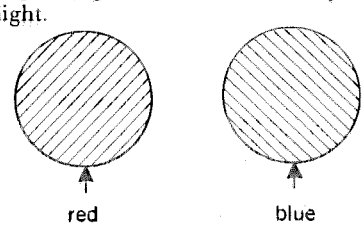
This is the *Kodak Carousel projector.* It projects slides. Carousels symbolize carefree abandon. Care lest slides jam can be abandoned. Gravity feeds them. Gentle gravity. Slides are automatically lifted back to 80-slide storage tray. Pushbuttons at end of long cord advance slides, reverse, even refocus. (Latter is largely for kicks. Slides get prewarmed not to pop out of focus.) See Kodak dealer for exact price.

First, though, consider the picture below. It's an experimental viewing device. An image is projected on a translucent screen. No matter how sharp the original picture, the simple machinery behind the screen can *always* improve the sharpness. It integrates out optical noise. It also makes the screen more pleasant to stare at. Some very purposeful staring is being done today.

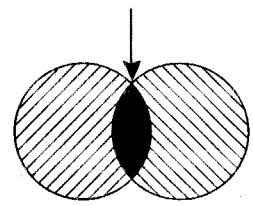
Our long research on human vision has more than happy-time slides in mind.

Overlap in black

What would you say to a photographic paper that comes out red or blue—depending on the color of the exposing light.



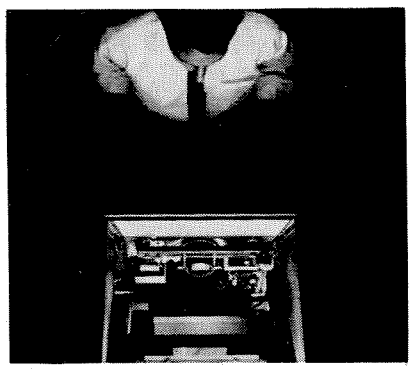
and black where they overlap?



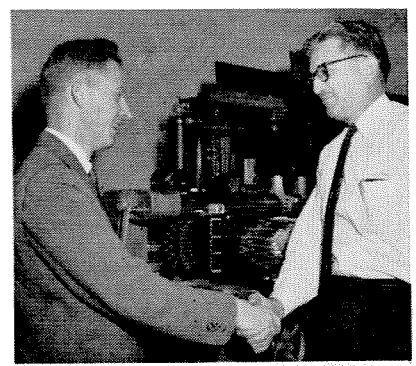
We are currently advertising around in various technical journals like *Geophysics, Materials Research and Standards,* etc. to ask if anybody would be interested in buying some rolls of paper like that for experimentation. It might be useful in interpreting the readings of certain kinds of instruments. You never know till you ask.

Note: Whether you work for us or not, photography in some form will probably have a part in your work as years go on. Now or later, feel free to ask for Kodak literature or help on anything photographic.

CELLULOSE TECHNOLOGY NEEDS GOOD PEOPLE



VISUAL ENGINEERING NEEDS GOOD PEOPLE



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One of a series . . .

Interview with General Electric's Dr. J. H. Hollomon

Manager—General Engineering Laboratory

Society Has New Needs and Wants—Plan Your Career Accordingly

DR. HOLLOMON is responsible for General Electric's centralized, advanced engineering activities. He is also an adjunct professor of metallurgy at RPI, serves in advisory posts for four universities, and is a member of the Technical Assistance panel of President Kennedy's Scientific Advisory Committee. Long interested in emphasizing new areas of opportunity for engineers and scientists, the following highlights some of Dr. Hollomon's opinions.

Q. Dr. Hollomon, what characterizes the new needs and wants of society?

A. There are four significant changes in recent times that characterize these needs and wants.

1. The increases in the number of people who live in cities: the accompanying need is for adequate control of air pollution, elimination of transportation bottlenecks, slum clearance, and adequate water resources.

2. The shift in our economy from agriculture and manufacturing to "services": today less than half our working population produces the food and goods for the remainder. Education, health, and recreation are new needs. They require a new information technology to eliminate the drudgery of routine mental tasks as our electrical technology eliminated routine physical drudgery.

3. The continued need for national defense and for arms reduction: the majority of our technical resources is concerned with research and development for military purposes. But increasingly, we must look to new technical means for detection and control.

4. The arising expectations of the peoples of the newly developing nations: here the "haves" of our society must provide the industry and the tools for the "have-nots" of the new countries if they are to share the advantages of modern technology. It is now clearly recognized by all that Western technology is capable of furnishing the material goods of modern life to the billions of people of the world rather than only to the millions in the West.

We see in these new wants, prospects for General Electric's future growth and contribution.

Q. Could you give us some examples?

A. We are investigating techniques for the control and measurement of air and water pollution which will be applicable not only to cities, but to individual households. We have developed, for example, new methods of purifying salt water and specific techniques for determining impurities in polluted air. General Electric is increasing its international business by furnishing power generating and transportation equipment for Africa, South America, and Southern Asia.

We are looking for other products that would be helpful to these areas to develop their economy and to improve their way of life. We can develop new information systems, new ways of storing and retrieving information, or handling it in computers. We can design new devices that do some of the thinking functions of men, that will make education more effective and perhaps contribute substantially to reducing the cost of medical treatment. We can design new devices for more efficient "paper handling" in the service industries.

Q. If I want to be a part of this new activity, how should I plan my career?

A. First of all, recognize that the meeting of needs and wants of society with products and services is most important and satisfying work. Today this activity requires not only knowledge of science and technology but also of economics, sociology and the best of the past as learned from the liberal arts. To do the engineering involved requires, at least for young men, the most varied experience possible. This means working at a number of different jobs involving different science and technology and different products. This kind of experience for engineers is one of the best means of learning how to conceive and design —how to be able to meet the changing requirements of the times.

For scientists, look to those new fields in biology, biophysics, information, and power generation that afford the most challenge in understanding the world in which we live.

But above all else, the science explosion of the last several decades means that the tools you will use as an engineer or as a scientist and the knowledge involved will change during your lifetime. Thus, you must be in a position to continue your education, either on your own or in courses at universities or in special courses sponsored by the company for which you work.

Q. Does General Electric offer these advantages to a young scientist or engineer?

A. General Electric is a large diversified company in which young men have the opportunity of working on a variety of problems with experienced people at the forefront of science and technology. There are a number of laboratories where research and advanced development is and has been traditional. The Company offers incentives for graduate studies, as well as a number of educational programs with expert and experienced teachers. Talk to your placement officers and members of your faculty. I hope you will plan to meet our representative when he visits the campus.

A recent address by Dr. Hollomon entitled "Engineering's Great Challenge — the 1960's," will be of interest to most Juniors, Seniors, and Graduate Students. It's available by addressing your request to: Dr. J. H. Hollomon, Section 699-2, General Electric Company, Schenectady 5, N.Y.

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All applicants will receive consideration for employment without regard to race, creed, color, or national origin.