—*Armour.*

SR/Research

SCIENCE & HUMANITY

DEPARTMENTS: Research in America • Letters to the Science Editor • Science in Books • Personality Portrait—XXX • The Research Frontier

ARTICLES: Coming to Terms With The Cosmos

RESEARCH IN AMERICA

• *GLOWROPE*
• *THE SCIENCE OF PEACE*
• *HOW IS A BABY?*

THE photograph at our masthead this month was not intended to be spooky. The picture had to be taken in darkness if it were to ɩell its story effectively. The story is not easy to believe. The gist of it is that light can be carried on a rope, through all the coils and turns that a rope can make, and then be beamed from the rope's end at any object it may be desirable to illuminate.

This particular kind of rope is made of glass. It is the subject of extensive experiments at the Armour Research Foundation of Illinois Institute of Technology in Chicago. One experiment is depicted above. Readers who think they see the fold of a turban on the experimenter's forehead are correct. He is an Indian-born physicist, Dr. Narinder S. Kapany, supervisor of optics in Armour's physics research department. The source of light is to the left at the bottom of the picture, and Dr. Kapany is holding one end of the glass rope against it with his right hand. The rope itself can be seen glowing between his right hand and his left hand, the thumb and forefinger of which are turning the rope's end back toward the camera.

What may look to the uninitiated to be a mere parlor trick is actually an exploration of the possibilities of a new branch of the science of optics, known as fiber optics. Each glass fiber in the rope carries a separate image of a distinct segment of whatever is being conveyed, whether it be a beam of pure light or the reflection of an object illuminated by a light beam. This discreteness would enable a photograph or a map or a written or typed word message to be scrambled and transmitted as a scramble. Such intelligence could be radioed without fear of detection by any interceptor who did not know the code used by the scrambler.

Unscrambled images could be carried piecemeal from the receptor tubes of TV to a TV screen with much less loss of light than occurs in presentday methods of TV picturemaking. In some experiments, the Armour people say the glass rope has achieved picture effects one hundred times the brightness attainable by older methods of photography.

Far more exciting from the human point of view is the apparent possibility of using the light-carrying rope to examine the interior of the body to detect cancers and other anomalies in regions to which instruments with fixed lenses are now "blind."

• • •

PRESIDENT EISENHOWER'S offer of late August to cease nuclear bomb test explosions if the Russians agree to certain conditions is related, perhaps to a substantial extent, to the appointment last November 7 of an Assistant President of the United States for Science and Technology. And it can be said with assurance that the move is only the first in implementation of a new policy toward employment of the international traditions of science in the nature of our dealings with the Soviet Union.

This is what logically might have been expected from the man we introduced to our readers when Dr. James Rhyne Killian, Jr. was summoned to the White House from the presidency of Massachusetts Institute of Technology. In those Sputnik-harried days we found the new Assistant President not only an intensely busy man but a determinedly reticent one, and we drew the flavor of his personality less from personal contact with him than from careful reading of speeches and essays he had written. Since he had begun his career as editor of the *Technology Review* at MIT, and had distinguished himself as an appreciator of literary style, it was easy to put his own words together into a sharply focussed image. The image was that of a poet who happened to be a scientist and who saw or felt nothing contradictory in his being so.

In drawing this likeness, we used four Killian quotations as perspective points. One of these deplored the "barbarian infiltration" of propaganda that science "endangers man's nobler aims and ends." A second stated the conviction that the scientist, like any specialist, "must be politically and morally responsible; he must test his actions by their human impact." The third was an observation that "peaceful applications (of science) are far more important to our security in the long run . . . than augmenting military strength." And the last was an expression of belief that science, through its oblivion to political boundaries in the search for truth, "can be a powerful agent in promoting peace among nations."

This image of Dr. Killian was entirely unfamiliar to the American people. They knew practically nothing about him except that the Lincoln Laboratory at MIT had designed a continent-wide battle machine in which electronic "brains" directed automatic fire of missiles at regions of sky where enemy invaders would be at the time the missiles got there. But an MIT faculty member offered a small wager that if Killian stayed at the White House more than a few months everything we had said about him would be borne out in action.

The months passed. Killian stayed. Then, in an entirely different connection, we lunched with physicist Hans Bethe on the Cornell University campus in Ithaca, N. Y., on Saturday, April 12. Anticipating a conversation about the stars, we were surprised to find ourself listening to talk about peace among men.

"Earth satellites and missiles are a very small and relatively unimportant part of science," the professor told us in the interview we reported in SR/Research for May. "The attention they have attracted has exaggerated the comparative scientific strength of Russia and the United States. Their very existence, however, makes it clear that we cannot expect to dominate the Russians. We have to learn to live with them. If we are to live with them in peace, we must relieve the tensions which now exist in the world. I believe we could make a start by having a moratorium on nuclear bomb tests. A moratorium wouldn't solve any great problem. It wouldn't be too important in itself. But it would be a beginning."

Professor Bethe explained that if we had met just one week earlier, he couldn't have discussed a moratorium. It was a confidential item then in the deliberations of the Science Advisory Committee which reports to President Eisenhower through Assistant President Killian's office. Professor Bethe was a member of the Committee and chairman of its panel on the feasibility of monitoring nuclear explosions.

"At this moment the Russians for their own reasons want to relieve tensions," he declared. "We ought to act while they are receptive."

"Why, then, don't we have the moratorium? What's the problem?" we asked him, and he replied:

"Until Dr. Killian's appointment to the White House, the President himself was the only man there with a broad view. All of the advisors he turned to on arms questions were in the Pentagon or the Atomic Energy Commission. They wouldn't be doing their jobs if they didn't oppose a moratorium. Perhaps a different Secretary. . . . The professor caught himself. "Dr. Killian," he said, "is consulted on many questions of state. Everyone trusts him. His opinions carry great weight."

No doubt the cabinet member whom Professor Bethe was on the point of mentioning that April afternoon was Secretary of State John Foster Dulles. Dulles for a long time had been sympathetic to the views of the then chairman of the Atomic Energy Commission, Lewis Strauss and Strauss's protege Edward Teller, who doesn't believe any kind of living arrangement with the Soviets is possible. The longer Killian stayed at the White House, the further Dulles moved away from Teller and Strauss. The first open evidence of the split with the AEC was the Secretary's cooperation with Killian in restoring a Science Adviser to the State Department. The growing division was confirmed by Strauss's retirement from the AEC and shortly thereafter Teller's resignation from the Science Advisory Committee.

It would be inaccurate to suggest that the influence of the American scientific community, focused through Dr. Killians office, was alone responsible for what came about. Larger domestic and foreign political forces were also in motion. But the views of the Assistant President for Science provided a sound technical base from which a broad public sentiment could make itself felt.

Hans Bethe was one of the two Science Advisory Committee members who successfully negotiated the nuclear test monitoring specifications with Russian scientists at Geneva. The words the President used in appraising those negotiations are a close paraphrase of the words Professor Bethe used in talking to us last April. "An agreement (to suspend nuclear weapons tests) is significant," the President said in his public statement, "if it leads to other and more agreements. It is in this hope that the United States makes this proposal."

• • •

THERE has been a happy conjunction in timing between the work of Dr. Killian's office and the United Nations's two-year study of biological effects of radiation. The UN findings were announced on August 10. They substantially confirmed what *The Saturday Review* has been saying repeatedly: Nuclear bomb fallout cannot be disregarded as a danger to world health.

How extensive the threat is—that is, how many people are doomed by the ashes of a given bomb of a particular size—remains to be determined by further research. But there can no longer be any honest question that the smallest amount of exposure to radiation does alter genetic structure and thus visits the penalties for this generation's carelessness on future generations. At what point immediate physical damage to those now living begins is still debatable; but the damage certainly occurs.

The Russians tried to put sharp teeth into the UN report with a concluding paragraph demanding termination of nuclear weapons tests at once. This effort was voted down, and the face the report presented to the public bore so many qualifying features as to seem at first glance almost innocuous. But there was a hidden political reality that helped to move President Eisenhower.

The Marines in Lebanon had become a diplomatic liability for the United States, and an Afro-Asian neutral bloc of twenty-eight UN votes was floating between the East and the West. Which way would the bloc go? Hardly toward any accommodation for the West in absence of some recognition of the implications of the radiation report to rice-eating populations of the world.

Rice-eaters, the report had pointed out, run five to six times as much risk from Strontium 90 as do milk-drinkers. In Western countries, Strontium 90 from fallout enters man's body by way of the soil through green plants that are eaten by cows. At each step in this process, nature filters out some of the radioactive poison. Rice eaters have no such filter to protect them. They swallow the Strontium 90 directly in their rice.

There was no real hope, then, for any prompt resolution of the Near Eastern crisis without at least a gesture toward nuclear bomb test suspension.

• • •

THE Atomic Energy Commission pretended that the UN report amounted to concurrence in the AEC's approach to the fallout threat. And newspaper editors of the country allowed the false pretense to pass unchallenged. In truth, the tone of the UN findings was an implied rebuke to the AEC's pollyanna attitude.

• • •

HOW is a baby born?

In spite of all the millions of women who have borne children, the act remains a medical mystery.

A fetus is expelled from the mother's uterus.

A money-saving pre-publication offer on a landmark in scientific literature

Moments of Discovery

TWO VOLUMES, BOXED

A remarkable insight into the creative process in science — presenting 2500 years of scientific achievement in the words of 83 of the leading scientists of history from Hippocrates to Einstein . . . from the discovery of the law of the lever to atomic fission. Edited, with a wealth of background information, by George Schwartz and Philip Bishop; introduction by Linus Pauling.

Volume One
The Origins of Science

Volume Two
The Development of Modern Science

- Over 1,000 pages total; nearly 500,000 words; more than 50 rare illustrations.
- To be published in November at $15. Special Prepublication Price: $11.95

Agricola	Lamarck
Archimedes	Laplace
Aristotle	Linnaeus
Bacon	Lister
Becquerel	Lucretius
Boyle	Malpighi
Brahe	Mendel
Cavendish	Mendeleev
Copernicus	Newton
Curie	Oppenheimer
Dalton	Pascal
Darwin	Planck
Descartes	Pliny
de Vries	Poincare
Dutrochet	Priestley
Einstein	Ptolemy
Faraday	Redi
Galileo	Roentgen
Gay Lussac	Sarton
Geber	Scheele
Gilbert	Schwann
Halley	Spallanzani
Harrison	Stahl
Harvey	Swammerdam
Hertz	Theophrastus
Hippocrates	Thomson
Ingen-Housz	Van Helmont
Jeans	Van Leeuwenhoek
Jenner	Vesalius
Kepler	Volta
Koch	Wohler

And others — 83 in all

THE EDITORS

GEORGE SCHWARTZ, Fellow of the New York Academy of Science, is a prominent science educator. *PHILIP W. BISHOP*, Head Curator, Department of Arts and Manufactures, U.S. National Museum, Smithsonian Institution.

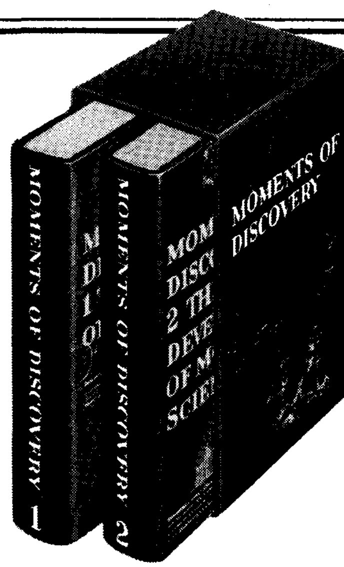
THIS unique two-volume set brings together the personal, first hand accounts of the dramatic "moments of discovery" that have contributed to the advance of science — from its beginnings in the ancient world to the present day. These epochmaking discoveries take on new significance when re-created in the actual words of the men who made them, providing meaningful new insights into the nature and growth of science.

How, for example, did the minds of the great astronomers actually work? Tycho Brahe, writing in 1572, begins: ". . . in the evening . . . I noticed that a new and unusual star . . . was shining directly over my head where there never before had been any star.".

Or, what was it like to peer into the new world of the microscope in the 17th century? Van Leeuwenhoek delightedly reports ". . . many little animalcules very prettily a-moving . . . sometimes stuck out two little horns." Van Leeuwenhoek did not realize their significance, but the reader of MOMENTS OF DISCOVERY — thanks to the editors' commentary — more fully appreciates the importance of the achievement in a broad scientific perspective.

You relive with Edward Jenner the first fateful test of his smallpox vaccine: ". . . I selected a healthy boy about eight years old, for the purpose of inoculating for the cowpox. The matter was taken from a sore on the hand of a dairymaid, who was infected by her master's cows, and it was inserted, on the fourteenth day of May 1796, into the arm of the boy."

In MOMENTS OF DISCOVERY, nearly one hundred such



great events in science are brought to life in the words and drawings of the scientists themselves. Scarcely a name or discovery of consequence has been omitted. Aristotle and Archimedes . . . Geber and Agricola . . . Galileo, Newton, Cavendish, Halley, Thomson and others.

More than one fourth of the boxed set is devoted to biographical, cultural and historical commentaries by the editors which amplify the meaning of the achievements of the great scientists. Through them, the reader is afforded an accurate perspective from which to relate past scientific accomplishments to contemporary progress, problems, prospects and to the unity of science itself.

Volume One, *The Origins of Science*, depicts the evolution of scientific thinking up to the scientific revolution of the 17th and 18th centuries. Volume Two, *The Development of Modern Science*, knits together the strands of accumulated knowledge in biology, chemistry, physics, astronomy, medicine, electronics and other epochal advances of *modern* times.

Encyclopedic in scope, MOMENTS OF DISCOVERY is fascinating reading, whether taken as a continuous narrative or as individual selections

SPECIAL PREPUBLICATION OFFER

MOMENTS OF DISCOVERY will be published early in November at $15.00 the set. However, we invite you to order your copy now *in advance* — and to receive this two volume work at the special price of $11.95, plus postage. Examine MOMENTS OF DISCOVERY free on publication for 10-days. Return it without obligation if you are not delighted. Send no money now, simply give the Reservation Certificate to your bookseller or mail it direct.

RESERVATION CERTIFICATE

To Your Bookseller or 119
BASIC BOOKS, Publishers
59 Fourth Ave., New York 3, N. Y.

Please reserve .... first edition set(s) of MOMENTS OF DISCOVERY. In November, send me the set(s) for FREE ten-day examination. Within that time I'll either return them or send my check for the prepublication price of $11.95, plus postage.

Ship to:

Name..

Address..

City..............................Zone....State...........

☐ Check here if you are enclosing full payment now. We pay postage. Same return privilege.

BASIC BOOKS, PUBLISHERS New York

That is really all science knows.

This knowledge can, of course, be stated at greater length. Indeed, it was, in the July 1958 issue of—note the distinctly unmedical name of the publication—*The Review of Scientific Instruments.*

"The mechanisms by which the fetus is expelled from the mother's uterus involve a complex array of biochemical and physical processes," wrote Thomas I. Marx of the Midwest Research Institute of Kansas City and Charles A. Hunter, Jr., of the University of Kansas School of Medicine. "One of the most salient features of this process is that the fetus is forced into the world by the mechanical power exerted by the uterine muscles."

But they, too, had to say:

"At the present time, the manner in which these uterine muscles are controlled is largely obscure."

Since too many babies are killed by abnormal physical forces exerted by the uterus upon the fetus during labor and delivery, doctors are eager to assuage their ignorance of the mechanisms involved. Research has been undertaken in the last few years in a new discipline of biophysics called *tokodynamometry*—the measurement of uterine forces.

In their July report, Marx and Hunter described a *tokodynamometer* (TKD) they are testing at Kansas University Medical Center. It corresponds very roughly to a telegraph key that is taped lightly on a pregnant woman's abdomen.

The TKD operates on the following set of principles: First, when muscles contract, they shorten. Since the uterine muscles encircle the uterus, when one or a group of them contracts, it causes a change in the curvature of that part of the uterus and the abdominal wall above. As the abdomen adjusts, the movement is amplified and recorded on a graph. By comparing the graph curves, contractions of different parts of the uterus can be correlated.

"The purpose of this investigation," Marx and Hunter explain, "is directed towards the evaluation of the effects of various drugs and anesthetic agents on the uterine contractions in normal and abnormal labor. . . . The work is aimed at improving contraction patterns . . . by the use of drugs."

• • •

THE first American attempt to shoot a rocket around the Moon failed long before the rocket reached the real problem areas of its projected trip. The vehicle blew up just one minute off the ground. The newspapers left it there, and the lay public still has no conception of the intricacies that would have been involved in the remaining 3,359 minutes of a Moonward passage.

The Air Force has played coy about the details, but at least a good approximation of them can be read in past reports of the Rand Corporation. Rand is a research laboratory at Santa Monica, California, which operates independently as a military brain. Some of the finest mathematicians and operations research specialists in the country are on its staff. In May 1956 one of those staffers, George H. Clement, wrote a paper entitled The Moon Rocket.

Clement postulated a three-stage voyage, only the first stage of which would be powered. The second stage would be taken over by the gravitational pull of the Earth and then by the pull of the Moon. The third stage would be a braking stage involving a reverse rocket.

Having thus accomplished one reduction in the formidable math equations of a Moon trip, Clement cut complications again by arbitrarily assuming an altitude of 350 miles above the Earth as the point at which the rocket's power should be cut off.

At that altitude, any speed greater than 35,165 feet per second would carry the vehicle out of Earth's gravity field, never to return. At any speed less than 35,165 feet per second, the rocket would sooner or later come back to Earth unless it collided with the Moon or another body en route. To coast across the quarter million miles which separate the Earth from the Moon, the rocket would have to be traveling 34,800 feet per second when its last motor quit.

The duration of the trip to the Moon would vary, naturally, with the rocket's speed: at 34,800 feet per second, four days plus; at 35,000 feet per second, two-and-a-half days; at 35,500 feet per second, one-and-a-half days.

Clement picked 35,000 feet per second as a desirable speed, and a takeoff angle of 108 degrees at an altitude of 350 miles above the Earth. To hit the Moon at any point on its face, he found, the velocity could vary no more than eighty-five feet per second. But if the rocket's velocity could be held within those narrow limits, the voyage would be completed in two-and-a-third days. Starting in a direction considerably behind the Moon, the vehicle would curve in its course under the influence of Earth's gravitational field so that after the first half day the heading would be in almost a straight line toward where the Moon would be two days later.

Since American space scientists are now virtually committed to avoid a crash landing on the Moon (for fear of contaminating the satellite's atmosphere and so perhaps destroying a record of past life in the solar system), the actual complexities of the pending Moon voyage (four more tries are scheduled, two by the Air Force; two by the Army) are barely suggested by Clement's paper. Another Rand report, written by H. A. Lieske in February 1957, probably gives a more realistic picture. According to Lieske's calculations, a rocket that doesn't hit the Moon but merely circles it and comes back to Earth may not get closer to the Moon than 80,000 miles and may not return to Earth until as long as twenty days after it is expected. If it is to land within 1,000 miles of any chosen spot on Earth, the rocket's initial velocity cannot vary more than *three inches* per second. Merely to bring the vehicle back anywhere on the Earth's surface would require control ten times as precise as that achieved with Vanguard.

There is a third Rand study which may be even more to the point than the others. Written by Robert W. Buchheim in June 1956, it analyzes the problems of turning a rocket into a moon-for-the-Moon.

The initial speed for this maneuver would be in the same 35,000 feet per second neighborhood. The rocket would pass 1,000 miles above the Moon's surface 2.12 days after leaving Earth. At that point, the vehicle's velocity would be 7707 feet per second, far too fast to permit an orbit around the Moon. Somehow the speed must be cut sharply to somewhere between 5,338 and 3,280 feet per second. Only a reversing rocket, carried along for the purpose, could be so effective a brake. If its fuel were solid, the brake-rocket skin would have to be fabricated to fit the time of the month and thus the period during which the Moon rocket's travel path would lie in full sunlight. If the brake were to act evenly, the carrier rocket could not be allowed to roll during its several days of travel. The braking rocket could not be fired by a preset clock because the carrier vehicle might be as much as four hours late in reaching the Moon's neighborhood. Someone will release the brake by pushing a button at the right moment in Hawaii. Why Hawaii? Because that archipelago will be in a straight line of sight with the Moon when the rocket is due 1,000 miles off the Moon's face.

What happens after that depends, among other things, on the purpose of the trip. Is this to be merely an exploratory look at the far side of the

Moon—the hemisphere we never see? (Actually, we do see almost a tenth of it as the Moon wobbles back and forth in its orbit, and astronomers have charted craters even beyond that peripheral region by calculating the extensions of beams of light that are reflected over the horizon). Such an exploration is hardly better than a publicity stunt. Scientists take it for granted that one half of the Moon cannot be too different in its cosmically meaningful characteristics than the other half. But if that's all the military has in mind, the job can be done by equipping the rocket with a pair of electric eyes to distinguish light from darkness and radio the picture back to Earth.

Far more valuable scientifically would be a Moon satellite that would stay in orbit and be observed long enough to give us accurate information about the magnetic field of the Moon. For this purpose, Rand staffer Buchheim noted, "it would be highly desirable to make it (the satellite) observable as a passive body—its useful life could then be essentially endless." "One way to enhance the visibility," he pointed out, would be "to arrange the design so that the vehicle, once on orbit, is made into a white reflecting thin-walled metal sphere."

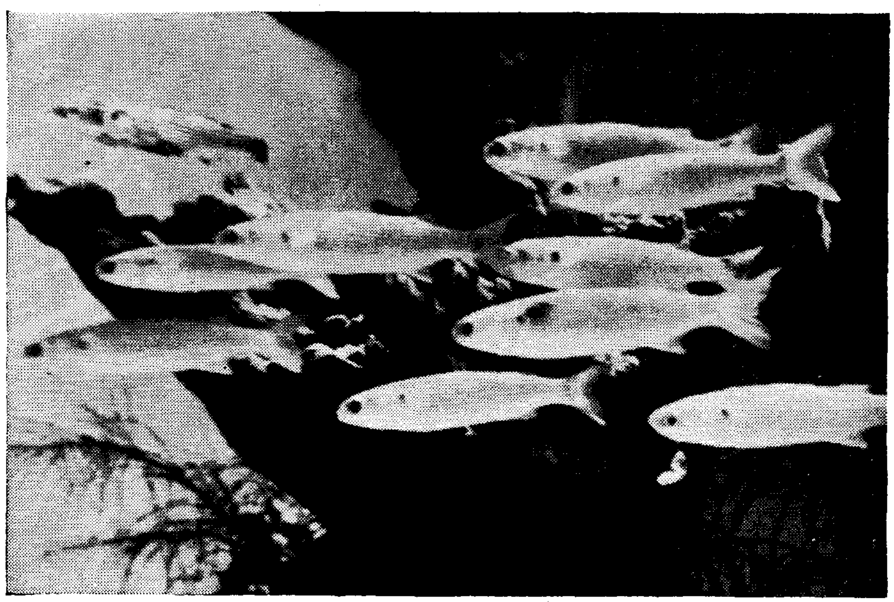
Aluminum foil one ten-thousandth of an inch thick would do for the skin of this sphere. How big should the sphere be? Big enough to be seen against the light of the full Moon. Since the magnitude of full moonlight is 12.55 on the astronomer's scale, the satellite's magnitude would have to be somewhere between ten and six. Translated into feet of diameter, this puts the satellite's size between 132 and 832 feet across.

• • •

MANY wonders of the sea have been brought to our attention since we devoted *SR*/RESEARCH for June to a study of the Earth as a water planet. Our favorite among these is the Barber of the Bahamas.

The Barber is a tiny blue and white shrimp that sets up shop on the head of a sea anemone, the flower-like coral whose petals are stinging tentacles. The tentacles guard the shop against possible invasion by jealous competitors while the Barber sits there and advertises his skills with an ancient forerunner of the modern terrestrial neon sign—blinker and all. Rocking back and forth, the enterprising tradesman swishes his theatrically long white antennae briskly through the water to attract passing customers.

Transient fish react to these enticements very much as men respond to



the undulant coloured rings in an old-fashioned barber pole. They slow down and then stop. The one who is "next" puts himself confidently into the Barber's claws and assumes awkward postures in the water, not unlike the bendings and slumpings human barbershop clients go through in meeting the onslaught of clippers and razor.

The Barber of the finny world has been observed to be a gregarious character, which will surprise no man who has survived a land-locked haircut. He goes over each customer meticulously from head to tail, shaving off the often invisibly minute copecods—the socalled "lice of the sea"—which infest most of the better classes of oceanic inhabitants. The fish opens its gill cavities one at a time to allow the Barber to enter freely in pursuit of his work. That done, the customer opens first his mouth and then his throat. The Barber disappears from view as his task progresses. At last he emerges, and the fish swims off a cleaner and younger-looking individual.

Sometimes fish fight for the right to be "next" in the barber's chair. On occasions the battles are vicious. Better-behaved customers line up so solidly in front of the barber shop that the barber himself is not infrequently obliterated completely from view.

Discovery of the Barber of the Bahamas is credited by the Smithsonian Institution to Vern and Harry Pederson. Actual collection of a specimen that now graces the Smithsonian marine collection in Washington, D.C. was made a few months ago by Conrad Limbaugh of the Scrippps Institution of Oceanography at La Jolla, California.

The phenomenon of sea barbering has been described in the scientific literature often before, and is probably worldwide. The Bahama Barber's operation, however, is more highly organized than anything previously reported. The Barber keeps hours as regularly as his human brothers. Customer fish "showed a definite pattern in their daily arrival, obviously related to a diurnal patterned life. Longer term studies undoubtedly would have shown seasonal trends," Limbaugh said in a recent talk before the Western Society of Naturalists. That latter remark, we suppose, means that fish barbers have an easier time when some of the customers are on migration, much as landlubbing barbers enjoy a lull during the summer holidays. To make up for this slack period, the Barber of the Bahamas goes over as many as 300 fish in one six-hour stretch of daylight.

—John Lear,
Science Editor

LETTERS TO THE SCIENCE EDITOR

NOT SO FARFETCHED

In the August 2nd issue, (Research in America) you have some comments about "moondust," which both interest me and puzzle me. As I first read the piece, I thought it meant that some scientists believe that if they could get some of the "moondust" they could experiment with it in an effort to "find the secret of life." After several readings, I realized that you do not say this, and I was relieved, because that sounded too farfetched.

The quotation, "to assess the prebiotic synthesis of organic compounds," doesn't clear things up because I don't know whether it assumed that there was synthesis of organic compounds before life existed, or whether it took place or not.

Could you elaborate a little on this question, in some future issue, for non-scientific minds?

Edward D. Williams.
New York, N. Y.

Editor's Note: *Reader Williams was correct the first time. The belief is that cosmic dust has been falling on the surface of the Moon and piling up there at least as long as evolution of the universe has been in a sufficiently cool phase to permit life to spring from the cold chemistry of creation. It is assumed that some inanimate, sterile clay existed capable of being transformed into self-perpetuating organisms. The instrument of transformation may have been a lightning flash. Prof. Harold Urey and others have demonstrated in a test tube that electrical discharges can convert dead chemicals into amino acids, the so-called building blocks of life. The implications of finding missing links from this chain on the Moon are obvious. Astronomers generally expect to find life on other planets of other stars than our own Sun. The article beginning on page 51 is an elaboration of the question and man's rational response to it.*

GRATUITOUS COMPLIMENT

We like the article, "Concerning A Rumor in August," which appeared in the August 2 issue of *Saturday Review* (SR/Research) because it is a clear and straightforward review of the original report ("The Effects of a Threatening Rumor on a Disaster-Stricken Community," by Elliott R. Danzig, Paul W. Thayer, and Lila R. Galanter). While this may be a gratuitous compliment for the *Saturday Review*, we feel it worthy to note that your reviewer resisted the temptation, so often succumbed to by writers in this field, to editorialize or sensationalize about human behavior in disaster. This field contains serious and complex problems for research and planning which are only obscured by overdramatic reporting.

I would only comment further, for readers interested in the subject of human behavior in disaster, that the study not only deals with the origin and spread of the rumor and with the gross response of the population, as covered in the review, but that it also investigates in some detail the factors which determined whether a person who heard the report left town or whether he stayed.

Harry B. Williams
Disaster Research Group
National Academy of Sciences
Washington, D. C.

Editor's Note: *The full report can be obtained from the National Academy of Sciences, 2101 Constitution Avenue, N.W., Washington 25, D. C. Price: $2 a copy.*

GOAL OR GOALEE?

The article entitled "Science and Dishonesty" (*SR*/Research, Aug. 2) was intensely stimulating. How ironic for man to be so capable of explaining the world about him and yet so unable to explain why and how he is capable of doing this.

In order for the scientist to seek truth he has to be emotionally motivated to do so and yet this very pursuit can distort his conception of it, especially when it concerns himself. The very goal itself can limit if not prevent its own attainment for the scientist has already handicapped himself by his very commitment to one certain goal.

The mystery of the universe is not after all the universe but the mind that so desperately wants to understand it.

Lorne H. Ward.
Azusa, Calif.

CAP(TION)SIZED BUT AFLOAT

I enjoyed reading your section (SR/Research) on Oceanography in the issue of July 5, 1958, but I feel that there was a substantial omission in the story. The unfamiliar reader might not be blamed for thinking that all significant oceanographic investigations in this country are being conducted at Scripps and Woods Hole. This, as I am sure you know, is far from the case. Lamont Geological Observatory may be one of the younger institutions, but its work deserves more recognition than the one line reference in Mr. Iselin's article.

Unfortunately, this overall impression is further emphasized by errors in the figure caption on page 38. The Physiographic Diagram of the Atlantic Ocean was indeed first published in the Bell System Technical Journal (September, 1957), but the chart was the culmination of a project undertaken by the Lamont Observatory. Most important, Dr. Heezen and Miss Tharp are not employees of the Bell Telephone Laboratories, but members of the staff at Lamont Observatory.

H. Nelson Upthegrove.
Murray Hill, N. J.

Editor's Note: *Thanks to reader Upthegrove for correcting our blooper on Dr. Heezen and Miss Tharp. But we would not have him believe that we are neglectful of Lamont's work. The Science Editor invited a contribution from Lamont to the Oceanography issue, could not obtain one before our deadline.*

COMING TO TERMS WITH THE COSMOS

Man Must Grow to Reach the Stars

—*Harvard Observatory.*

As our sky deepens, human yearnings may be reflected in new star shapes. In photo above is today's Southern Cross.

Editor's Note: *Though man has failed in his first attempt to send a rocket around the Moon, he has at least begun to try. Given the past, the future seems clear: He will continue to try until he reaches not only the Moon but Earth's sister planets of the Sun and then the planets of other stars. When he succeeds he will be confronted with a question more momentous to his own ego than any other question he has ever faced: Are other beings like him living in the distant sky? Most astronomers say "Yes." Most other people haven't thought about it seriously. It is time they did. For them, Prof. Harlow Shapley has written a wise and witty primer: "Of Stars and Men" (Beacon Press, $3.50), excerpted below.*

By HARLOW SHAPLEY

THE goal of this writing is to present some information and ideas, new and old, bearing on the position of mankind in the universe of physics and sensation. It is an essay on orientation.

To postpone a possible depression about our role or function in the stellar universe, and to evade for a time the heavier implications of man's physical position, we could first emphasize the good features of life under the present constellations. We might introduce this essay in an optimistic vein, since later there will be time and need for a more somber look.

It is a good world for many of us. Nature is reasonably benign, and good will is a common human trait. There is widespread beauty, pleasing symmetry, collaboration, lawfulness, progress—all of them qualities that appeal to man-the-thinker if not always to man-the-animal. When not oppressed by hunger or cold or man-made indignities, we are inclined to contentment. . . .

But rather than a lighthearted and somewhat evasive view of our situation and responsibilities, it would be more in keeping with what lies ahead to adopt from the beginning the attitude of mature inquirers, and confront the cosmic facts squarely and fully: small but magnificent man face to face with enormous and magnificent universe.

For the sake of simplicity, we are tempted to put all the world of physics and perhaps all the biological world into the framework of four properties. They are, of course, space, time, matter, and energy. May there be others, perhaps some of even superior importance? In particular, is there one other property of the material world that is essential to make the universe go? To put the question in personal terms: If you were given the four basic entities and full power, opportunity, and desire, could you construct a universe like this one out of space, time, matter, and energy? Or would you require a fifth entity?

We seem to belabor this mystical fifth entity. That it exists, we can hardly doubt. Is it a master entity, perhaps more basic than space and matter and possibly including them—something quite unlike the four named above? Is it indispensable?

Some readers may be thinking of the word and concept God, but we should not be hasty in such a deep and critical matter. Let us not use up that important and comprehensive concept for only a part of the universe, or for something already comprehensible to primitive us.

An elementary reason for a reconsideration of mankind as a world factor lies in the recognition in recent years of the "displacement" of the Sun, Earth, and other planets from a central place, or even a significant place, in the sidereal universe—in the placing of the observer in a very undistinguished location in a faint spiral arm of an ordinary galaxy.

This reason is elementary but momentous, for it concerns the replacement of the earlier *geocentric* and *heliocentric* theories of the universe by the *eccentric* arrangement that now we all accept. By this move we have made a long forward step in cosmic adjustment—a step that is unquestionably irreversible. We must get used to the fact that we are peripheral, that we move along with our star, the Sun, in the outer part of a galaxy that is one among billions of star-rich galaxies.

Man may be something very special, something superior. He may be. I hope he is. But certainly it is not in his location in space, or in his times; not in his energy content or chemical composition. He is not at all outstanding in the four basic material entities—space, time, matter, energy. Nothing unique and worthy of boast in his size, activity, composition, or his epoch in cosmic chronology. He is of course an intricate and interesting phenomenon, but we should get sentimental about him with restraint.

There should be, however, nothing very humiliating about our material