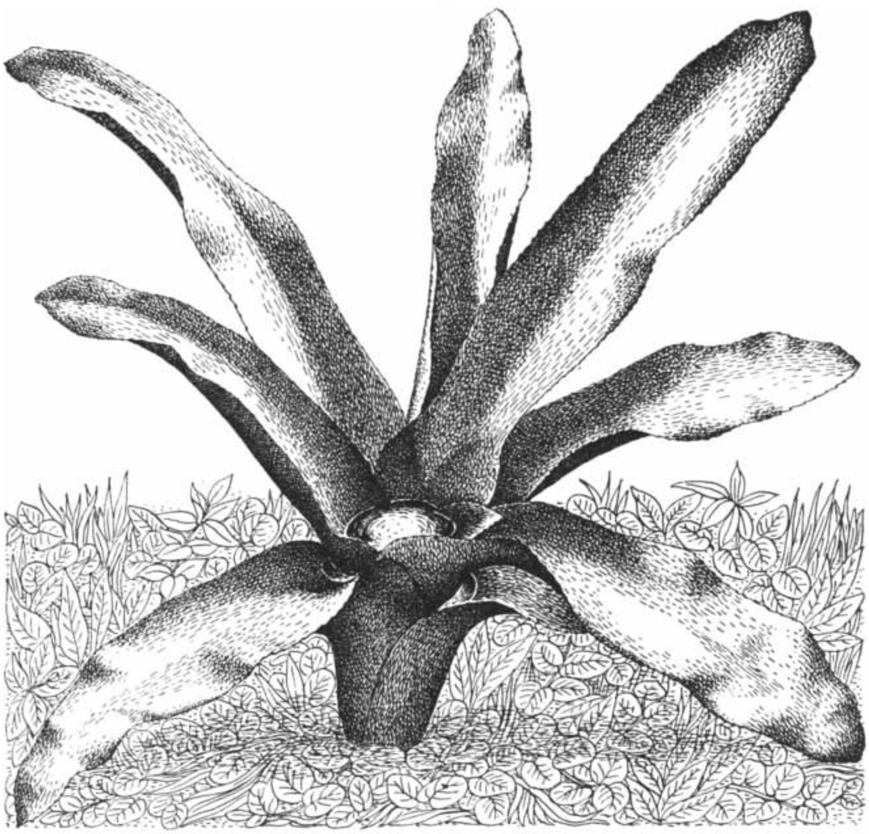
Is Man Alone in Space?

He sometimes wonders if, on a planet similar to the Earth, another genus Homo has arisen. An anthropologist considers the possibility in the light of what we know of evolution

by Loren C. Eiseley

MAN bitterly resists the lonely thought that he may be the only creature of his kind in the universe. We are basically cosmopolitan; we long for companionship in the great adventure of space. We want to radio Mars and get back the equivalent of "How yuh, boys?" Our hope that we may not be alone in space is nourished by the theory of probability. In the millions of planets and infinity of time—surely there must be a possibility that man is not a unique event. If somewhere in the universe there is a world exactly like ours, why not a manlike creature there?

The probabilities are less favorable than they may seem. Man is not simply a matter of a throw of the dice which might have fallen just the same way on another planet. Even if there were another world exactly like ours in all its physical conditions, we still could not guarantee that identically the same life would emerge. Man, life, worlds are the product of multitudinous concatenations of singular events which could never be duplicated in their entirety. At any point in the last billion years the line of evolution that produced man might have taken another turning—and we would never have appeared. The proposition of duplicating man is something like that of the proverbial monkeys working through eternity to type Shakespeare's works again by chance—only the probabilities, if any, are much worse, and time is not infinite but limited.



TANK PLANT, a member of the bromeliad family, is an example of evolutionary adaptation to one unusual environment. The plant lives aloft in trees, obtaining water from rain or dew held in its closely fitted leaves. It is nourished by plant and animal matter that falls into the water.

Opposed to the attempt to project man across the light-years lies a series of well-nigh insurmountable physical and biological obstacles. In considering the likelihood that man has been duplicated on remote worlds, two important physical events have to be considered before we can turn to the nature of life itself: the age of the universe and the way in which solar systems come into existence. The answer to the first proposition should indicate the length of time in which statistical probability has operated; the answer to the second should give us some idea as to whether life is a rare or common occurrence in space.

Ironically enough, there are quite disparate views on both subjects. Fifty years ago there was a widely held belief in the infinity of time. While old star systems burned out and died, new systems emerged. "Eternal motion," wrote one weary Russian in 1875, "does not cease, and new worlds eternally develop in place of former ones." The idea of an eternal universe allowed the possibility of the spores of life drifting from the wreckage of burned-out systems to systems beginning anew, and an infinity of time in which man might arise again and again. But we have now acquired the growing suspicion that we live in an expanding universe which had an incredible beginning and threatens to have an even more fantastic end. Time, in the only sense we can know it, is limited, surprisingly limited. The evidence, though we shall not examine it here, is impressive and drawn from diverse sciences. It has led numerous students to acceptance of the following conclusion:

At some point approximately 4 to 10 billion years ago, all matter composing the known universe was concentrated under inconceivable pressures at one point in space. In this "monobloc," whose contracted density abolishes our everyday experience of space, time and matter, life is inconceivable. It could only emerge later, after the titanic explosion which sent both space and stars racing outward upon a course which threatens to carry the galaxies out of sight. "Standing on a cool cinder," remarks Canon Lemaître, "we see the slow fading of the suns." Their stores of radioactive energy, though great, are not inexhaustible, and unless some unknown source of renewal awaits them, they are destined to go dark.

IN THE LIGHT of this interpretation, it now becomes clear that whatever existed prior to the monobloc can have no bearing on the life of today. Infinite time is *not* at our disposal in estimating life's capacities, but rather the indeterminate moment in the afterglow from a great explosion whose fires are dying.

A few have attempted to escape the horns of the dilemma by recourse to the assumption that matter is somehow being created continuously in space, although this process has never been observed. In the apt words of Herbert Dingle of London University, "It exempts us from having to postulate a single initial miracle on condition that we admit a continuous series of miracles." The idea, true or untrue, has no supporting evidence.

We know that to achieve a single creature capable of advanced thought on the Earth has taken over one billion years. There is nothing in this time span, or in our knowledge of evolutionary processes, to suggest the easy duplication of man. To begin with, while the number of planetary systems may be large, most planets, on the evidence from our own system, probably are unsuitable for life.

The British biologist Cyril D. Darlington argues that "if a creature like man is a sound proposition on the Earth, then similar creatures, built on a similar plan, would also be well fitted to an existence on other planets." He dwells enthusiastically on the advantages of two legs, a brain in one's head and the position of surveying the world from the splendid height of six feet. Apparently he has never paused to consider why, if the advantages of the human body are so obvious, one creature alone, out of the million or more species currently inhabiting this planet, should have assumed this particular form. Moreover, it has been a very late experiment, and in spite of its "superb construction," the wounds of its evolutionary break with its origin still show quite plainly. In bad sinuses, easy rupture and maladjustments of 50 varieties, including varicose veins and a plethora of back and foot troubles, man reveals the imperfections of a bodily machine still in evolutionary adjustment to an environment different from that which he has only recently escaped. This is not to denigrate the real values of the human body and brain, but we must realize the incredible wanderings by which man has attained his present position if we are to estimate the statistical likelihood of a creature like man emerging on the red deserts of, say, Mars.

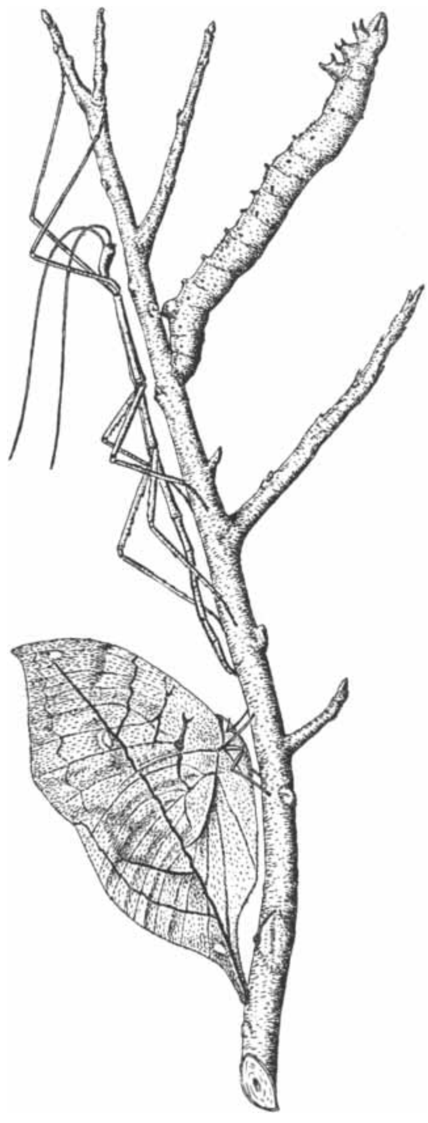
The artists who draw ingenious pictures of two-footed, thin-legged, big-chested Martians do not bother to consider just how the geologic and geographical background of Mars might have promoted (or hindered) such a development. Every organism has a history. Here we can learn from the multitude of different worlds present on the Earth. Surely, if any duplications of the life we know are to be observed, our own planet should be more apt to produce them than the unrelated worlds of space.

TO BE SURE, we can see examples of life mimicking life on every hand. Not long ago the noted deep-sea explorer Otis Barton climbed into an aluminum cage in the tropical rain forest of Africa and was cranked upward into a strange new world, similar to that of the other great rain forest in the Amazon basin. Almost 200 feet above ground, high in the tree tops, is an interwoven mass of vegetation teeming with animal life—a curious attic world. Like the deep sea, it has no seasons; light is the main consideration. Innumerable plants have climbed into this sheltered niche above the floods and turmoil of the world below. Climbing vines as thick as a man's thigh loop back and forth. Upon this mass of supporting cables has settled a weird assemblage of orchids, ferns and other strange plants which seek the sunlight and have learned to dispense with the ground below. Some are parasitic upon other plants; some depend on the precarious debris of their uncertain floor or the exhalations of trees. The eternal hot-house damp of the rain forest enshrouds them all and makes this dreamlike landscape possible.

In the Amazonian attic are plants, known as bromeliads, which form tanks that catch and hold quarts of water. Dust and humus and drowned insects collect here to nourish the plants. Tree toads, frogs and numberless insects live their lives in these aerial ponds. Monkeys and protectively colored green tree snakes hunt by ancestral paths through the scent of the orchid gardens.

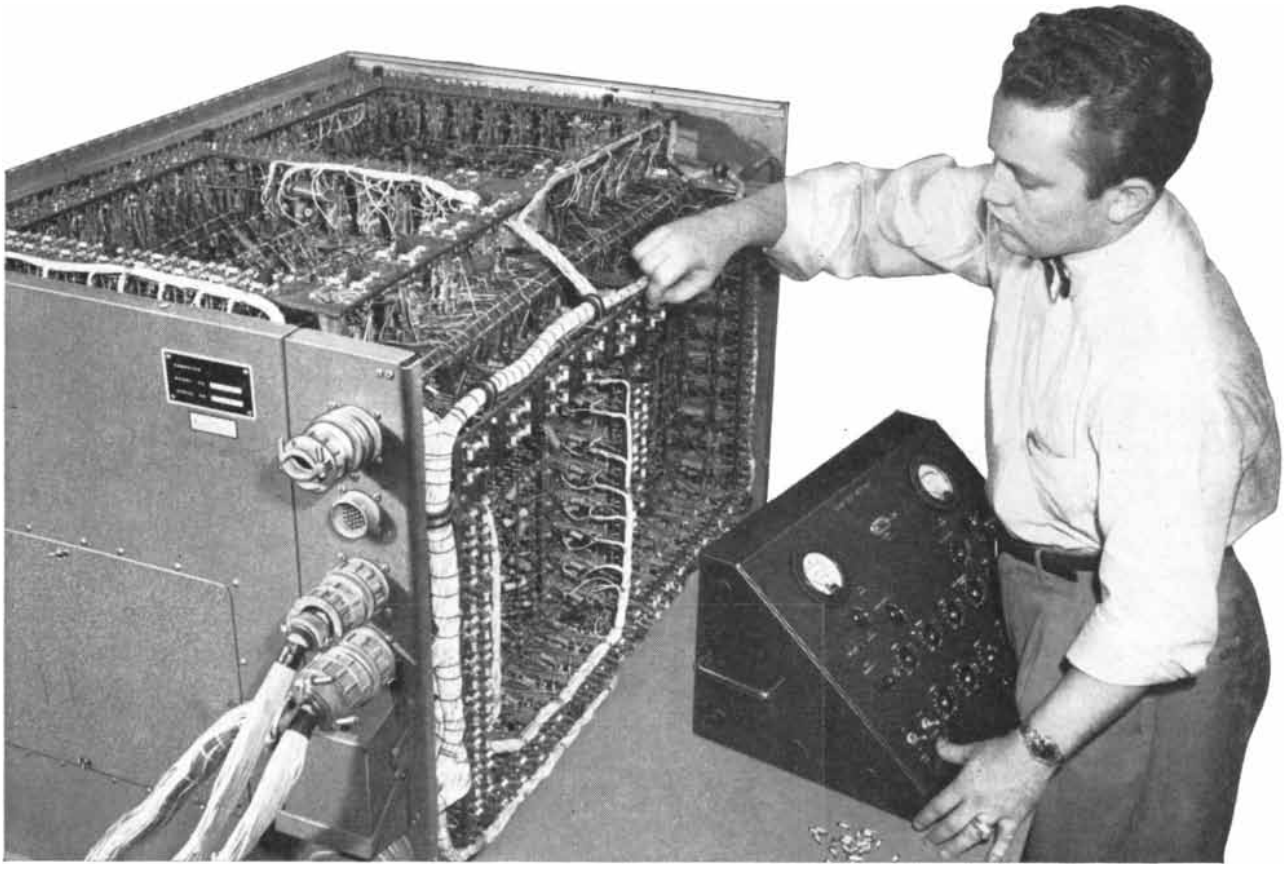
This world possesses some amazing duplications of living forms. Henry Bates, a keen 19th-century explorer of the Amazon, told how he suddenly encountered one day a menacing little monster which thrust itself through the leaves into his face. At first glance the startled Bates thought it was a poisonous viper. Actually it was an enormous caterpillar, with black pigment spots which looked like eyes. In the high chambers of the upper tree world are butterflies of diverse and distantly related families which are nevertheless surprisingly alike in coloration: beetles so burnished that they shine on the tips of vegetation like drops of morning dew, sticklike insects with legs like stiff, angular branches, bits of dead bark that turn out to be alive, spiders in the shape of flower buds, flies masquerading in the dress of stinging bees, crickets like wasps, brown and spotted butterflies that look like moldy leaves.

Resemblance to a dangerous insect or animal, as in the case of Bates' caterpillar, offers the protection of a formidable species to a harmless creature. Mimicry of a repulsive or ill-tasting species may save an insect from the birds. Adept



CAMOUFLAGE is another example of evolutionary adaptation. Here a caterpillar, a "walking stick" and a leaf butterfly blend into a twig.

ENGINEERING BRAINS TEAM WITH ELECTRONIC BRAINS



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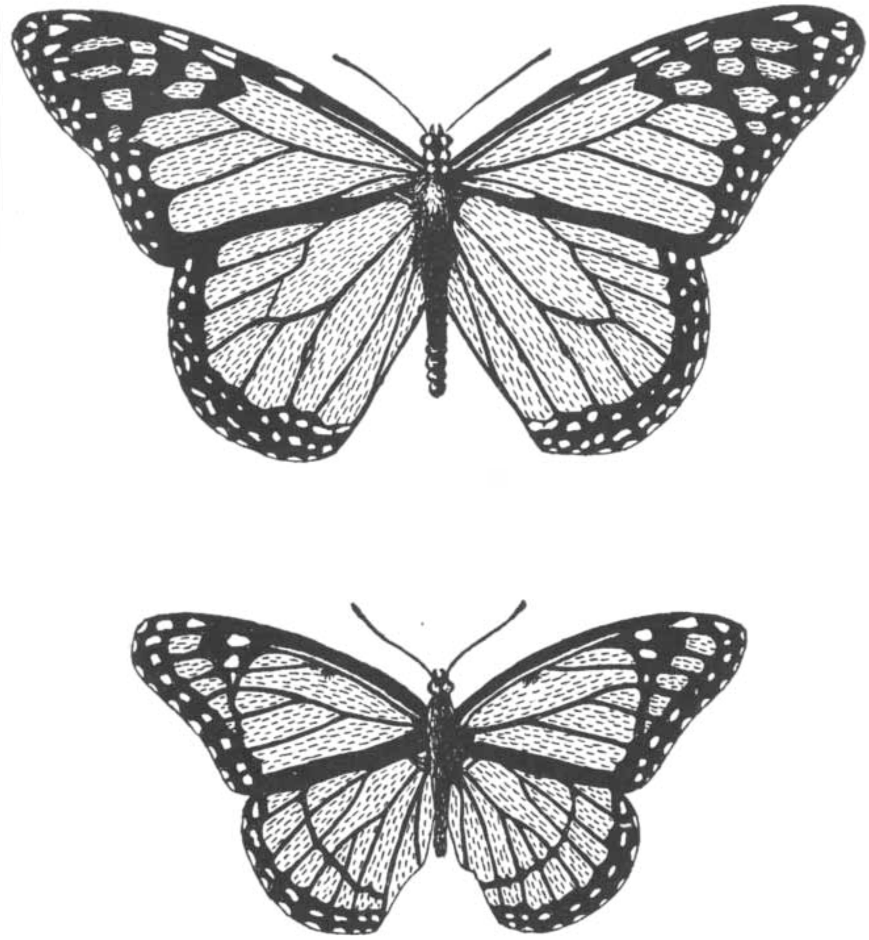

MIMICRY of the monarch butterfly (*top*) by the viceroy butterfly (*bottom*) is thought to be due to the fact that the former species has an unpleasant smell which discourages its natural enemies. The viceroy butterfly, which does not have this odor, is presumably protected by the visual resemblance.

camouflage is so valuable to small life that natural selection may carry it to high peaks of perfection. Yet all this masquerade is only skin deep. The mimic never *becomes* the model, any more than the walking-stick insect becomes a twig. The mask may fool the mimic's enemies, but it will not deceive a zoologist.

SUCH PRINCIPLES have nothing to do with the possible duplication of man on other planets. No animal is likely to be forced by the process of evolution to imitate, even superficially, a creature upon which it has never set eyes and with which it is in no form of competition. Nor could an animal, however gifted in mimicry, ape a man if it came among men. Aside from the impassable anatomical obstacles, the individual sitting next to you in the theater could not conceivably be an insect masquerading as a man. Even if the body duplication (down to clothes) was perfect, the creature's instinct-controlled brain, its cold, clock-like reaction, in contrast to our warm mammalian metabolism, would make the masquerade hopeless.

Among the plants, too, we note many parallelisms. Yet the forms of the plants do not duplicate one another. Their relationships are not obscured, and what is even more interesting, a really remarkable invention such as the bromeliad reservoirs may distinguish the whole upper-story world. Nothing like them is known in the African forest. Their unique little ponds, making possible the growth of other aerial plants, have seemingly given the South American forest roof a luxuriance which the African forest cannot totally duplicate. One unique plant invention, in other words, has affected irretrievably the destinies of a great variety of other plants, animals and insects *in one particular world.* A historic incident, the rise and diffusion of a specific, natural invention on one continent has so channeled a little stream of life that numerous organisms will never be the same again because of the creation of those aerial marshes.

This event does not emerge as inevitable. Most curiously, botanists have noted that the bromeliad water tanks probably were developed originally not in the rain forest but in the desert. Here was an adaptation developed for one world which paradoxically enabled the bromeliads to leave that world for a very

different one—the dappled sunlight of the orchid gardens. Anyone pondering the seeming stolidity of the plant world should consider it well—that long climb from a desert to a forest top.

It is out of such small events that worlds are altered beyond recall. As George Santayana wrote years ago: "An infinite number of solar systems . . . must have begun as ours began, but each of them must have deviated at one point from ours in its evolution, all the previous incidents being followed, in each case, by a different sequel."

ON THE great tablelands of Tibet, explorers say, the wind is always blowing. Dust devils dance endlessly across the landscape; air eats away the solid rock. Behind stones, under stones, buried in the soil, innumerable creatures hide from the force of the wind. Creatures which in other lands fly free and high here cower behind boulders or dart hastily from one bit of shelter to the next. Some insects have lost their wings. From birds to beetles, instincts have been altered in order to enable the animals to contend with this windy world. This is a land, the space writers sometimes argue, like the cold Martian desert itself.

Mars, with its thin air, its almost vanished oxygen and vast regions of desert, is a waste planet. A few apparently seasonal color changes suggest but do not entirely prove the possibility of some type of vegetation. That vegetation cannot be of a high order. There is simply not enough water on the planet to support a widespread forest and grass cover like that of our Earth. We need not explore these well-known facts extensively. Rather, what I should like to emphasize is the total lack of seas on Mars. The planet very early in its history lost a great deal of its water, and very likely it never did possess anything like the turbulence of our giant seas. On the Earth it is the constant circulation of water from sea to clouds to rivers and back to the sea that has nourished the higher life. The fossil hunters tell us that this circulation is probably indirectly responsible for the appearance of backboned animals. It is in the rivers of the early planet that the shape of man was born, for they were the birthplace of the vertebrates.

Here, then, is one of those deviant points upon which, as Santayana intimated, the destiny of a world might hang. A world like Mars, of feeble puddles, of leveled mountains, will breed a different life, if it breeds life at all. The pulse of the Earth to a very considerable extent is the sea's pulse. The altitudinal swing of the continents, the great periods of mountain building, rework the very shape of life itself. Multitudes of living things are forced to readapt upon the land and also in the sea. Upon Mars, back into a time as far as we can grope, the water has run scant and small. Equally scant and small we may expect its life to be. Nowhere in all that red array of sand and rock could a creature ever rise on a spine like ours. If anything comes forward in that cold and shriveling air, it will be pinched and meager beyond all the imaginings of Earth.

Every day worlds end and worlds begin; last night's puddle dries in today's heat and its little living world blows away. Day and night, winter and summer, on the thin edge of the tides or the immaterial edge of evening, there come into being lives which are adapted only to a fine-drawn instant of existence. A single mutation in an unknown, innocent virus, a change in the gaseous composition of the air around us, a rise of temperature by a few degrees—any of these might sweep the human world away. Before morning, however, something else would be creeping up the stairs or nesting in the abandoned attic.

IN THE thin terrestrial film, whose depth is only the brief distance from the Pacific deeps to the Himalayan roof of snow, life has experimented for one billion years. Its forms in certain instances have lived even without oxygen; they have endured pressures and rarefaction and devised incredible, cunning schemes for survival. The plant and animal species developed on Earth must range into the billions. But in all Earth's varied worlds man, "the sound proposition," has appeared but once.

It is not my contention that in the long cycles to come some of man's traits, even to an advanced brain, may not emerge once more in other living forms. The complex life of the social insects has been repeated no fewer than 30 times in the long history of diverse and only distantly related creatures. One thing, however, is apparent: the same life does not come again, the same hands will never twice build the golden cities of this world. The time stream, the on-pouring, whatever we may call it, is far more original than this. It is as though nature had all possible, all unlikely worlds to make and would make them before the systems lapsed away into darkness.

I think sometimes of the account of a traveler who, far up in the Himalayan snows, watched in astonishment a flight of lowland butterflies caught in one of the mysterious migratory impulses of their race. High in that desperately cold and thinning air, the delicate-winged insects, strung out over a great distance in a long, flickering line, were moving upward! The tattered columns wavered; stragglers dropped frozen in the snow. Nevertheless the dying creatures headed indomitably upward toward the blue ice of the peaks, their little wings beating in unison as though the march might have been boldly outward toward the moon. They were a living manifestation of discontent; they were life going about its immense business of changing worlds—or perishing in the attempt.

What General Electric people are saying . . .

L. T. RADER

Dr. Rader is Manager—Electronic and Specialty Control Planning Study in the Control Department

". . . Regardless of the principle chosen, whether it be a new approach or a modification of an old one, the skill of the designer in designing for inexpensive and easy manufacture often is the difference between success and failure.

Men with a good knowledge of manufacturing methods are invaluable in determining if punch-press stampings can be used instead of expensive screw-machine products, or if it is better to use punched phenolics instead of molded parts. They develop ingenious methods of fastening components together, break a unit down into subassemblies to give flexibility, make certain that standard parts are used where possible, and in general, make certain that over-all product costs are maintained at competitive levels.

Because designers have so many diverse problems to solve, they are always willing to try new materials that may offer design advantages. It is far easier—and less risky—to make ten samples of a pressure switch out of a new material and have them field tested, than it is to try the same material on a large and expensive machine.

Because of this, we find that insulating materials such as the silicones, permafil, nylon, and teflon are applied in small devices almost immediately upon discovery. Special magnetic materials like oriented silicon and alnico have also found immediate application. Plastics of every formulation and property and special metals like stainless steel, curie metal, beryllium copper, and Z-nickel have been used immediately upon development. In the area of current conduction and interruption, special alloys made of combinations of practically all known metals are used extensively for their special properties. Because of its nature and form, small apparatus design eagerly accepts new materials almost immediately upon their release to industry and finds useful work for them to perform.

G. E. Review

C. G. SUITS

Dr. Suits, a Vice President, is Director of the Research Laboratory

". . . Some calculations have been carried out in our laboratory recently, to determine in detail the quantitative effect of some typical lattice defects on tensile strength of metals. For the case of alpha brass they show that the magnitudes involved are sufficiently large to account fully for the experimentally observed tensile strength of the actual crystalline material. This recent work has, for the first time, made possible a quantitative understanding of this most important property of crystals. It would be difficult to overestimate the value of this work for it seems certain that great progress may be expected from a full development of current studies of crystal defects.

The study of the growth of crystals has provided a particularly good opportunity to observe the role of defects and dislocations. When crystals are grown from solution it is observed that the growth rate may vary widely from one crystal to another of the same chemical composition, and this difference can be explained by the relative abundance and character of the dislocations present. A particularly important defect in this case is the lattice displacement known as an edge dislocation. This defect arises from the displacement of many layers of atoms relative to their neighbors, on a line perpendicular to a plane of the lattice. Consider the function of this edge dislocation in a crystal experiencing growth from a supersaturated solution. Atoms from the solution migrate to the crystal where they are held by surface forces, which however are particularly weak on an atomically smooth plane of a perfect crystal. In the neighborhood of the edge dislocation, by virtue of the geometry, these forces are very much greater, with the result that practically all of the crystal growth phenomena takes place at these points. The abundance or scarcity of such defects can thus account for a vastly different rate of crystal growth in different crystals of identical chemical composition, the most perfect crystals experiencing the slowest growth.

at The American Philosophical Society
Philadelphia, Pa.

R. E. FALCONER

Mr. Falconer is a meteorologist at the General Electric Research Laboratory

". . . It seems to the author that there may be an electrical effect associated with the jet stream which can be readily detected by as simple a device as a radioactive collector and a suitable sensitive current
or recorder.

However, before drawing definite conclusions, observations at other locations around the country should be made to determine more definitely whether the electrical effects observed at Schenectady apply generally. It is suggested that a network of such instruments might be useful for continuously checking on the location of jet streams. Such information might be useful in detecting the possibilities of tornadoes, thunderstorms, turbulence, and general precipitation since all appear to be related to the effects of the jet stream.

The author has now found that a General Electric photoelectric recorder having a sensitivity of 0.266 microamperes shunted to read 0.50 microamperes full scale is about the right sensitivity to use. Such a recorder was recently installed and this eliminates the need for an electrometer which tends to drift and cause misleading results unless a frequent zero check is maintained.

at The American Meteorological Society
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