MISSILE KITS

Seven giant models of the Army's Guided Missile Defense System reproduced in precision detail from OFFICIAL U.S. ARMY PRINTS! Order yours now!

DART NO. M-12
Boxed with Little John

NIKE HERCULES NO. M-14
Over 21" long

LITTLE JOHN NO. M-12
Boxed with Dart

NIKE AJAX NO. M-13
Over 17" long

TALOS NO. M-15
Over 15" long

HONEST JOHN NO. M-16
Over 13" long

CORPORAL NO. M-11
Over 22" long

M 11—Corporal—22" Long—$1.79
M 12—Dart and Little John—$2.30
M 13—Nike Ajax—17" Long—$.98
M 14—Nike Hercules—21" Long—$2.00
M 15—Talos—15" Long—$1.89
M 16—Honest John—13" Long—$.98

SPECIAL—All seven for only $7.50!!!
save $2.44!!

Order From
Missile Kits
316 Howerton
Nashville, Tennessee

NO C.O.D.'S PLEASE

https://louis.uah.edu/space-journal/vol2/iss1/1
In keeping with SPACE Journal's theme of projecting into the future, Harry Longe has created an imaginative representation of an Outer Space scene envisioned by Hoeppner and Isbell in the second part of their article Project Star to appear in a forthcoming edition. The landing vehicle, shown in the foreground, is being separated from the photon (light) thrust unit and prepared for re-entry into the Earth's atmosphere. In the background, another interstellar Space ship can be seen leaving our Solar System at near light speed. Actually, the photon ray would be invisible, since its wave length would be in the X-ray and gamma-ray region, but for illustrative purposes the light ray is shown with the rainbow effect of the entire light spectra.
TIME FOR A CHANGE!!

Beginning in France, the metric system has spread throughout the world displacing the local measurement system in nation after nation. The question of should America and England follow suit has been popping up ever so often for the last hundred years.

There has been considerable discussion, and some of the proponents of the British system of measure point out that Chinese shopkeepers still use an ancient system of measure and that Spanish units are not uncommon in South America. Although it is true that some trades still cling to the old ways, the overall trend is for the prevailing system of units to give way to the metric system.

If the world is ever to have a single system of measure, it must be the metric. Seven countries, including China, Russia, and Japan, have adopted the metric system since 1920; and the metric system has invaded both Britain and America. Much of our scientific research is conducted in metric units, the electrical and chemical industries using the same units throughout the world. This process is continuing as some groups, sometimes entire industries, switch over to a decimal system.

So it really boils down to a question of how long before America should adopt the metric system per se. The cost of conversion for some industries would be considerable; and some of these industries have influential Congressional lobbies. Another difficulty experienced in trying to adopt the metric system occurs in getting a majority of the people to favor something new and different. Teaching the metric system in Grammar School and High School would alleviate this and make the transition less painful.

The advantages of the metric system are:

1. It is simple.
2. It is a decimal system.
3. It is international in character

By Douglass B. Spears, Jr.

PROJECT ABLE AND BAKER

Two American-born female monkeys, Able and Baker, as the world now knows them, were launched in the Army's reliable Jupiter from Cape Canaveral on May 28, thus becoming the first primates to survive a trip through Space. They were recovered, along with other biological experiments flown by the Army, 92 minutes after liftoff from the Cape.

The Jupiter carried Able and Baker over a trajectory of some 1,965 Space miles with a maximum altitude of over 300 miles. They re-entered the atmosphere at a velocity of 10,000 miles an hour, experiencing 38 times the normal pull of gravity plus a weightless period of some nine minutes.

Able later died while undergoing an operation for removal of an electrode. The cause of death was a rapid and convulsive movement of the heart, following the administration of a light surgical anaesthesia, and was unrelated to the recent flight which the seven-pound Rhesus experienced.

The experiments, sponsored by the National Aeronautics and Space Administration, were carried out by the Surgeon General of the Army, the Navy and the Army Ordnance Missile Command. The Army Ballistic Missile Agency developed and launched the Jupiter missile and provided most of the special hardware for the experiments.

An interesting sidelight to Operation Monkey were the howls of indignation from the various humane societies. The animals were recovered in perfect condition, and scientists call the experiment a major step toward manned rocket flight. The participating services and agencies are clearly to be congratulated. And the monkeys? Not unworthily did they carry on in the tradition of the animals used in the Montgolfier balloon flights in 18th Century France! As for Monkey Baker's feelings in the matter, she couldn't care less.

https://louis.uah.edu/space-journal/vol2/iss1/1
Zdenek Kopal was born in Litomyšl, Czechoslovakia, in 1914, and was educated at Charles University, Prague; Cambridge University, England; and Harvard University. After finishing his work at Harvard University in 1940, he was a research associate and lecturer at that college. In 1942 he became a research associate in applied mathematics at the Massachusetts Institute of Technology. During World War II he worked for the United States Navy on a special project. Since the war he has served as a consultant to the United States in various capacities, including membership on the National Advisory Council for Aeronautics. A member of the Astronomical Society, the Astronomical Society of the Pacific, a fellow of the Royal Astronomical Society, and the International Astronomical Union, he has been since 1951 professor and head of the department of astronomy at the University of Manchester. He is the author of An Introduction to the Study of Eclipsing Variables, The Computation of Elements of Eclipsing Binary Systems, Tables of Supersonic Flow of Air Around Cones, and more than 140 technical papers in professional journals.

The recent Lunar probe firings by both this country and the USSR represent important steps in man's gradual penetration of interplanetary Space. Included in the instrumentation package of the Pioneer I probe and reportedly in the Russian Mecha planetoid were magnetometers which were intended to detect and measure the Lunar magnetic field (if any). These instruments were designed to telemeter back to Earth information of basic importance for rocket navigation in the immediate neighborhood of its satellite, as well as for orientation on its surface when the first intrepid travelers step out one day from their Space ship.

As the October 11, 1958 Pioneer probe (with the magnetometer) only went one-third of the distance (cislunar distance) separating us from the Moon and since the Russian Mecha telemetered results have not been reported, we are still lacking direct information on Lunar magnetism. However, several recent astronomical investigations carried out in terrestrial observatories have thrown considerable light on the question of a possible Lunar magnetic field, and, in fact, may have gone a long way towards answering it in the negative. The method employed to do so is based on studies of Lunar luminescence, and appears to be of sufficient interest to warrant explanation for the general reader.
In order to do so, let us pause briefly to answer the following question: what does the light of the Moon really consist of? As every school child knows, most of that which is visible to the eye is nothing but reflected sunlight, scattered by the rough Lunar surface in the direction of the Earth. As the scattering of light on rocks or dust particles does not affect its color, the spectral distribution of light so reflected should remain essentially identical with that of ordinary sunlight (though its coherence properties—such as polarization—may be altered somewhat.) Most (in fact, over 90 percent) of the incident Solar energy will be absorbed by the Moon to maintain its surface at a temperature which, at lunar noon, may exceed 100 percent at the subsolar point. As a body thus hot, the Moon is bound to emit radiation of its own, but almost all of it is emitted too far in the infra-red to be visible to the naked eye. Most of the real "moonlight" is, therefore, lost to the human eye. It can, nevertheless, be measured quite accurately by its thermoelectric effect; such measurements utilized for ascertaining the instantaneous temperatures prevailing on any particular part of the Lunar landscape are accurate to within a few degrees.

There exists, furthermore, another way by which the Lunar surface can, under certain conditions, emit light of its own; and that is by a process commonly called luminescence. As is well known, luminescence is the ability of certain substances to absorb light of relatively high frequency and re-emit it in installments of separate lower frequencies. In order to describe this mechanism in more specific terms, suppose that the atoms of a suitable substance are exposed to radiation (wavelike or corpuscular) capable of ejecting electrons from their normal positions. Such a damage to atomic structure is usually quickly repaired by each individual atom's capture of another free electron from the neighborhood. Such an electron may occupy the "hole" left by the ejected electron in one jump—in which case radiation of the same frequency as that which caused the initial damage should be emitted—but it may also (under certain conditions) accomplish its movement in steps. In this case, each time it drops a step, it loses that amount of energy, emitting discrete quanta at each transition (the sum of whose energies should add up to that of the original disturbance). The light emitted by such a cascade process is called the luminescent radiation, and should be familiar enough to the reader. The beautiful color display of certain minerals (such as uranium salts) under illumination by the "black light" of an ultraviolet lamp is an example of this process in action. To the engineer, luminescence offers an important tool for modern lighting techniques; and most gaseous nebulae photographed by astronomers in the sky owe their luminosity to this process (under illumination by neighboring hot stars).

Does any part of the Lunar surface exhibit similar luminescence? This question, which for a long time hung in suspense, appears to have been answered in the affirmative by recent spectroscopic work by N. A. Kozyrev of the Crimean Astrophysical Observatory in the USSR and by J. Dubois of Bordeaux, France. Their work, carried out independently and reported last year, seems to leave but little room for doubt that some parts of the lunar surface, notably the system of rays spreading out around the crater Aristarchos, indeed exhibit luminescent emission in certain discrete bands.

The method by which such results were obtained is indeed simple. We mentioned already that, in the absence of any luminescence the visible spectrum of moonlight should be essentially a true replica of that of the Sun, with all its absorption lines faithfully reproduced in the same intensity. A superposition of Lunar luminescence would render the solar absorption lines as seen in the spectrum of the Moon shallower at the respective wave lengths, and this is what Kozyrev as well as Dubois claim to have found and measured. The total energy emitted by the Lunar luminescence bands is, according to Kozyrev, of the order of $10^5$ ergs per centimeter second amounting to about 1 percent of the entire incident Solar energy.
Sketch of Russian Lunar probe, MECHTA, resting on handling dolly. Note magnetometer installed at end of probe.

If this emission were stimulated by absorption of sunlight, it would be necessary to assume that all its ultraviolet component is absorbed by the respective lunar substance in order to account for the intensity of observed luminescence; and this is most unlikely on physical grounds. Besides, even more revealingly, the intensity of Lunar emission bands appears to exhibit fluctuations from month to month by as much as a factor four (Kozyrev).

while the light of the Sun (apart from occasional short-lived flares) is known to be remarkably constant. This all shows conclusively that the actual source exciting Lunar luminescence cannot be sunlight itself, but rather solar corpuscular radiation—most likely protons—which are known to be ejected spasmodically in bursts from disturbed regions of the solar surface, and whose impact on the upper atmosphere of Earth has long been known to give rise to the familiar phenomena of polar aurorae.

The Moon does not possess any atmosphere to speak of, and the streams of solar corpuscles impinge directly on its surface. "Lunar
aurorae”—for this is what the phenomena reported recently by Kozyrev and Dubois actually are—originate, therefore, right on the ground, rather than (as on Earth) high above it. Observations indicate, however, also another difference between terrestrial and Lunar aurorae which is of fundamental importance for the study of the hypothetical magnetic field of the Moon: namely, whereas on Earth aurorae occur also at night (because incident solar protons can be deflected by Earth’s magnetic field), Lunar luminescence seems always to cease as soon as the Sun has set below, the horizon. This would indicate that near the surface of the Moon charged particles move in essentially rectilinear trajectories, which would not be true if any appreciable magnetic field were present. The lack of evidence of bending indicates that the intensity of any magnetic field around the Moon cannot exceed but a small fraction of the intensity of the corresponding field of Earth.

A second independent argument leading to the same general conclusion can be drawn from Kozyrev’s recent work. As is well known from the observed time-lag between the corresponding Solar and terrestrial phenomena, the bursts of Solar protons travel through Space at an average speed of about 1500 kilometers per second, and Kozyrev has shown that the stoppage of such a flux by the Lunar surface is indeed adequate to account for the intensity of the Lunar luminescence as observed by him. However in the vicinity of Earth, the local terrestrial magnetic field is known to accelerate Solar protons by a factor of two to three. A similar acceleration at the Moon should, however, render the Lunar luminescence to be four to nine times brighter than is observed. The actual intensity of Lunar luminescence leads again to the conclusion that if (as is highly probable) the Solar protons arrive at Earth and the Moon in approximately the same numbers, their acceleration in the region of the Moon must be small, or nonexistent, indicating again that the hypothetical Lunar magnetic field is not great.

If the arguments of the foregoing paragraphs are still somewhat tentative, it is mainly because the survey for luminescence of the visible Lunar face is still far from being complete. Not all of the Moon’s surface, to be sure, can be expected to show luminescence for it is mainly the property of substances containing atoms of heavy elements and these are likely to be as rare on the Moon as they are on Earth. Needless to say, the observed characteristics of the luminescent spectra should often be sufficient to identify the element, or even its compound, giving rise to these spectra. Thus Kozyrev claims to have identified the two
A distinct central peak is visible in this photo of the Moon crater Tycho which is 54 miles across and has 17,000 foot walls. (Photo courtesy of Armand Spitz)

bright bands observed by him at 3900°A and 4300°A in the light reflected by the rays around the crater Aristarchos with ordinary quartz—an identification which is, however, still highly tentative and perhaps disputable on cosmochemical grounds. The same is true of Dubois's identification of his observational results with the luminescence spectrum of the mineral known as Willemite. The Willemites are well known and rich ores of zinc; and if such were available on the surface of the Moon in large quantities, the prospectors of the future would certainly find a major strike across the intervening gap of Space. But, again, much work remains yet to be done before any such identification can be considered as really established.

In conclusion, one additional consideration must be pointed out which may come to be of great importance for the absolute dating of events giving rise to many distinct features of lunar surface throughout its long astronomical past. If, as Kozyrev conjectures, the material around Aristarchos is really quartz, it is well known from laboratory experiments that its luminescence could be effectively quenched by small admixture of iron deposited on its surface. Now, like Earth, the Moon is continuously sweeping up, on its journey through interplanetary Space, a certain amount of dust containing a definite metallic content. In this way approximately 10^-11 grams of iron should thus be deposited on each square centimeter of lunar surface each day. At this rate of deposit, luminescence of quartz in a vacuum should be effectively quenched in some 50 million years. Kozyrev suggests that the crater Aristarchos and the system of bright rays diverging from it cannot be much older than 50 million years, possibly less; and the reason why similar systems of rays around other craters (like Copernicus, or Tycho, for instance) appear to show no detectable luminescence at present may be due to their greater age (a view supported also by their lower reflectivity to ordinary sunlight).

The results summarized in the preceding paragraphs may help to compensate the reader for some knowledge denied us by a failure of October's Lunar probe to approach the Moon as closely as it was hoped. It may also demonstrate that, notwithstanding occasional failures, our knowledge of the fundamental physical properties of the Moon and of its surface continues to accumulate by diverse methods; and that, in particular, a great deal can yet be learned from astronomical observations which can be conducted from the surface of Earth (and, incidentally, at a trifling fraction of the expense entailed by the current Lunar probe experiments). However, we do not hesitate to hope for greater success by future probes.
It has become commonplace these days for people who a few months ago would never have considered reading Space fiction to look into the future—and the near future at that—and pronounce that the survival of nations in war and the character of nations in peace will derive henceforth chiefly from changes introduced by the exploration of Space.

Obviously the potential for change is there, but realizing it depends on many profound and complex qualifications. When we talk about the "brave new world" which the exploration of Space will offer mankind, we must clearly realize that whether or not mankind accepts that offer depends on the motives, perceptions, aspirations and values of men and the social forms with which mankind makes his world. What I hope to suggest is that the impact of society on man's exploration of Space will be at least as great as the impact of that exploration on society. And, since portions of this article may seem less than completely optimistic, let me add that I am one who has read Space fiction all his life with that mixture of both romantic and pragmatic attitudes which tended to characterize most of us who took Space travel seriously before October 4, 1957.

Each development or potentiality deriving from the Space Age will be understood, misunderstood or ignored to the degree it meshes with the values and clear sight of the people concerned with it. That man is a conservative creature when it comes to changing his personal world view is a common experience verified by many laboratory studies. Moreover, most people attend carefully only to experiences which are immediately significant in terms of their everyday life. People react to new experiences in terms of their learned and tested mode of responding to the world. They perceive in terms of their pre-existing values and beliefs. They try to mold new experiences into old contexts. If they do not fit that standard context, they are likely to ignore them altogether. Or, if they can somehow alter these new experiences to fit their standard viewpoint, the new experience may very well lose its unique implications and power. This does not mean that man does not change his values in the face of new experience nor that he cannot be taught to change them at a rate and in a direction more likely to benefit him. But it does mean that the conservative and selective processes as such will persist.

Donald N. Michael was born in Chicago, Illinois, in 1923. He received his Bachelor of Science degree, in physics, from Harvard University; his Master of Arts degree from the University of Chicago, in sociology; and his doctorate from Harvard University, in social psychology. From 1944 to 1946 he was an electronics engineer with the U. S. Army Signal Corps and worked on radar and signal communications developments. He has been an advisor to the Joint Chiefs of Staff of the Department of Defense and to the National Science Foundation. He is presently a senior research associate for Dunlap and Associates, conducting man-machine systems analysis studies for large weapons systems. A member of the Federation of American Scientists, he is also an active member of the Sigma Xi honorary society, the American Psychological Association, and The American Association for Public Opinion Research.
is every reason to believe that man will look at the new horizon of Space through aid eyes—when he is not storing at some totally different horizon altogether.

With these important human tendencies in mind, let us look first at the period from now until the time when man has the technological capacity to colonize Space on a large scale. What can we say about the impact of Space on man's horizons—his values and aspirations, his way of life during this precolonization-capability period? In general, we must not expect much basic change fast in most places—simply because the unique and significant aspects of Space exploration are not close enough in conceptual content or practical side to that which is important to everyday living for most people. This might sound like an astonishing, not to say ridiculous, statement in view of the amount of attention the satellites and the whole future of Space have received in the press, radio, and television. But the fact of the matter is that for most people the majority of news at best is simply news. It is novel; it is timefilling; it may be exciting, mysterious, threatening—but it seldom goes much deeper than that. At least it seldom goes deeper than a vague incorporation into some value system, unchecked for completeness, logical consistency or application to other problems. That is, when there is any response at all—and by no means is there always a response—one finds that the concepts are limited as follows: the Russian satellite is bigger; one goes to the Moon by rocket; Space weapons would be bad; we have got to beat the Russians into Space, etc. On the other hand, reality demands: what has size really to do with a satellite, or why take a rocket to get to the Moon, or what would a Space weapon do that an Earth weapon would not, and so on. Usually from the public one gets no answer to these; or the answer is in terms which would apply equally well to a bigger
In this medieval conception of Space travel, the voyager has reached the vault of the firmament and is investigating the mechanics of the heavens beyond.

Russian milk wagon, or a bigger explosion anywhere.

There is a deeper difficulty here than simply this ignorance and disinterest. To appeal to people and get their support, it must be done in terms which are meaningful and important to them. Hence, man-in-Space must be placed in terms of today’s important perspective and values. And, this situation is further confused by the conflicting interests of various groups that find the opportunities for realizing their own interests increased by the leverage provided by threat-based and hope-based appeals in terms of man-in-Space. Thus, in a very real sense, the present views of man-in-Space are serving in some areas to reinforce rather than to change pre-existing values; e.g., a popular view of international relations as being no more important than a football score, a simple extension of warfare into a new geographic area, an admirable extension of technological knowhow (with the “how,” as usual, unknown and uninteresting to the admirer), an appreciation of science as a good investment for a future material payoff (with science being a novel kind of stock market.)

The eventual contributions of man-in-Space in changing the values and attitudes of society
This very old painting, together with the others shown here, were done by the French astronomer, Lucien Roudoux, for an article on the tidal theory of the end of the world. Here the Moon is seen coming closer to the Earth and gaining a larger angular diameter. (Photo courtesy of Armand Spitz)

As the Moon approaches even closer it raises tides so high that virtually everything in the civilized world is engulfed except a few far inland cities. This would mean the destruction of a vast amount of property and possibly lives, if Earthman could not temporarily move to another planet. (Photo courtesy of Armand Spitz)

When the Moon comes within Roche's limit it will begin to break up as shown here. (Photo courtesy of Armand Spitz)

After the Moon has broken up, the Earth would have acquired a ring probably very much like that of Saturn. (Photo courtesy of Armand Spitz)

As the Moon approaches even closer it raises tides so high that virtually everything in the civilized world is engulfed except a few far inland cities. This would mean the destruction of a vast amount of property and possibly lives, if Earthman could not temporarily move to another planet. And this will come about chiefly as a result of face-to-face contacts and the resulting by-products of such contacts.

The scientist associated with Space projects, being rare and being representative of new ideas per se, will be in demand socially in avant garde intellectual groups and for adult education lectures. Thereby the more philosophical—and less precise—aspects of astronomy, Space technology and Space medicine will become the new speculation, partly replacing, partly merging with the traditional subjects of terrestrial politics, psychoanalysis, and the prevailing philosophies. Here, the greatest impact will be from the gradual absorption of the ideas of the new cosmologies. And much in the manner that Freudian ideas filtered and are filtering from these groups to the rest of the population through schools, magazines, service agencies, etc., we can expect, over a period of time, that certain ideas and values about man-in-space will become crude and popular commonplaces at some levels and subtle stimulants at other levels. Only gradually can there come to be new understanding and thereby new behavior and attitudes—much as the popular belief that psychoanalysis and sex are practically synonymous is giving way to an awareness in some quarters of the facts of nonsexual character neurosis and thereby to changes in values about child raising, mental health, etc. Certainly, we cannot expect a sudden and complete enlightenment in all sectors of our society and societies around the rest of the world. It has never happened with any important ideas.

However, there is a special group which may play a useful role in spreading the new values growing from the exploration of Space, and this is the children who play at Space-man today. Whether or not they take this interest with them beyond childhood remains to be seen. However, the unique fact in the
present situation is that never before have children rehearsed a role that really will not exist until they are adults. To be sure all of them will not fulfill this childhood role, but the fact that the reality lies ahead rather than in the past (as with cowboys and Indians) may stimulate them to retain a sensitivity for the various meanings man-in-Space can have for our future. Also, children have become one of the most convenient authoritative sources for parents and teachers on Sputnik and related matters these last months. The serious adult attention they have received may be heady stuff—sufficiently rewarding to generate a lasting motivation among some to remain among the informed over the years to come.

When, however, we come to the era of interplanetary colonization, the situation will have a very real potential for dramatic change simply because then the opportunity to participate directly in the experiences of Space travel, or at least by second-hand experience through the words and actions of persons who do, will make Space a significant part of everyday life. Hence, it must have its impacts on the attitudes and values that grow out of and channel everyday perceptions. But, even here, if we examine this circumstance more closely, it appears that the context in which Space colonization may take place will probably itself determine the values men hold toward Space much more than Space will determine the values they hold toward life on Earth. Let us look at some factors contributing to this context.

In the first place, the colonization of Space on the scale we are implying requires a mode of Earth-to-Space propulsion which does not now exist. That is, it must be cheap enough to make it worthwhile transhipping thousands of people and the necessities for the existence. Perhaps thermonuclear power, perhaps anti-gravity will do, but certainly not the present chemical propellants. The point is that such packaged power has tremendous political and social implications for utilization on Earth, too. Such a powerful fuel might well make this planet a Heaven on Earth as far as power requirements for such a circumstance go. If so, why submit to the dangerous and risky life of extraterrestrial pioneering? What are the rewards? Consider the picture of pioneers we usually depend upon to support our predictions about future pioneers: they were fleeing poverty, injustice, or ways of life they disliked or were willing to take large risks. But can we imagine that a colony on the Moon will be set up by similar types of refugees, given the overall costs, the technology, and the sophistication of present and future governments about the motives of those they govern?

With cheap power and automatized production, we can wonder whether in fact there will be any destitute people left who at the same time would make good colonists. Furthermore, if the trend to prefer security to quick gain continues—and there is little reason to believe it will not—we may have trouble recruiting many colonists on the basis of that incentive, too. And, with the ever-growing population, fitted into an ever-growing urban environment and subjected to the homogenizing tendencies of industrial civilization, we may very well end up with a society which psychologically and culturally prefers the close proximity of neighbors and the comforting surroundings of elaborate society to the relative isolation and insecurity of colonial life far from the "green hills of Earth." One can clearly detect this tendency in the frequent query, "Who would want to go to the Moon anyhow?" To be sure, there will be persons, even in such a society, eager to expand into new Space just because there are new horizons. But there may not be enough of them to repeat the historical image we all carry of the European pioneers to the New World. The Norsemen after all did not expand substantially into North America when they had the chance. There are many societies not imbued with the culture value of mobility we have...
traditionally stressed here. And everybody who can go sightseeing does not—unless it becomes the socially desirable thing to do.

Moreover, barring some unexpected breakthrough, such cheap Space ship power is many years off. But in that time we can expect to see vast developments in other areas besides Space research: in medicine, physics, chemistry, geriatrics, genetics, psychology, with profound consequences for international politics, leisure, work, war and peace, and the values that invest these human commonplaces. It seems sure that the creation of artificial life in the laboratory will shake more men's world views than will the discovery of plant life on Mars. The accommodations of nations or supranations to the impact of population growth—which 100 years from now may reach eight billion—to the impact of extensive automation, to ever expanding urbanization, will vastly and deeply affect the outlook and conduct of mankind. Thus to talk of the impact of the colonization of Space as if it were to be the singular new or profound experience of man is a most unfortunate and naive assumption.

We can ask then, why would large scale colonization be undertaken? For political aggrandisement or military security? If the power sources necessary for such colonization exist then certainly the impact of this power source on earthly matters will be so great that politics, nationalism, and military activity in the name of national policy will be so radically changed that we can't use our present depiction of them as an adequate basis for predicting the forces behind the colonization of Space. To replace our waning natural resources? Perhaps, but will raw materials be worth mining and growing on alien soil if we have the power to efficiently and profitably mine the sea and if we have a chemical technology rather than a metallurgical one? Overpopulation? This seems to be the most likely possibility—if there is no adequate switch to voluntary population limitation (and this seems highly improbable) and if people in large numbers prefer the rigors of colonization to the attraction of massive urbanization.

Our enthusiasms and high hopes for Space derive from our particular satisfactions with our way of life. These are not necessarily the satisfactions of our neighbor in this society or the others comprising our world today—nor will they necessarily become so far more than a relative handful of mankind. And we need to recognize this now lest we go racing off sinking a disproportionate amount of our human and material resources into Space development on the justification that it holds the primary key to man's future. The primary key may very well lie in some small genetics laboratory where one man on a $500 foundation grant is discovering how to control mutations. Or the key may lie in an electrode imbedded in a brain, stimulating decades-old memories with photographic sharpness. It leads one to wonder whether so many of our leaders would be convinced that the key to our future lies in Space if the Russians had come up with a variety of wheat that reached maturity in two weeks or a euphoria gas. And, therefore, one can wonder how long leadership will continue to see Space exploration as the place to put so much of our psychic and material energies.

We have attended to some of the social and psychological factors which we can expect to affect the interaction between man-in-Space and society. Let us turn now to the question: Just what is it about the exploration of Space per se which is supposed to enlighten man, deepen his wisdom of himself, broaden his appreciation and thereby make him more fully aware of his potentialities? The immensity of Space? The view of Earth as a tiny sphere, one world, and a small one at that? New wonders? New scientific and aesthetic discoveries? Elimination of earthly difficulties by their transformation into the challenge of creating new worlds and fighting new environments? All of them, of course. But none of these is truly a unique consequence of the exploration of Space. All are equally possible and equally as evident right here on Earth, if we but look, and listen, and imagine. The immensity of the Universe is just as apparent in the atomic nucleus or a honey bee. Our one world has been obvious to thinking men for some years now. The bell tolled well before Sputnik and Explorer. Our precarious foothold in the cosmos is written in the rocks, in famines, in the depredations of the million-year-old cockroach.
It seems that what we really do when we look to Space as the new frontier and the purifier of men's visions—what we really do is indulge in the primitive fantasy wishes of children that somewhere there is a good fairy who will make everything right. And this time the good fairy wears a Space suit. It is too easy for man to confuse a rational desire to escape from Earth with an irrational belief that thereby he will also escape Earth's present and continuing problems, his conflicts of interest, his battle within himself.

Certainly man's Space adventure can help profoundly to make a finer creature of him, but only if his adventures on Earth can do so as well. Essentially what this means to a social psychologist is that we must somehow raise our level of education to the point where most men most of the time can appreciate and actively absorb the implications of knowledge and developments in all areas sufficiently to let them enrich their personal philosophies. And obviously this kind of education is only in part a scientific one. Those experiences mentioned earlier which are supposed to broaden and deepen men can be sensed by the poet, historian, and philosopher with very little traditional scientific knowledge per se. But they do require knowledge and appreciation of self, of the nature of man and of his creative quests as a creative quest rather than as simply preludes to materialistic pay-offs.

To build a society of enlightened citizens is a far more monumental task than building a colony on Mars. To build such a society requires an understanding of the behavior of men and an application of that understanding to the improvement of society. For those who want most intensely for man to explore Space, the consequences of that exploration and the directions that exploration is permitted to take depend ultimately on how soon and how well we explore man. The inward frontiers are as challenging, as dangerous, as rewarding, and as fraught with social significance as any of those beyond Earth. The future of the exploration of man does not depend essentially on the exploration of Space but our future beyond Earth's atmosphere is most profoundly tied to what we learn about that expanding universe called man.

**AT LAST**—The Complete International Story of ROCKETERY AND SPACE EXPLORATION

*By Andrew G. Haley*

President, International Astronautical Federation

HERE IS the whole exciting story of modern rocketry from its earliest beginnings through World War II, right up to today's launchings of missiles and satellites. Here are the famous men and milestones in the development of rocketry... facts on rocket production in the U. S. and abroad, and a glimpse of the fantastic future of Man's conquest of space.

**How Rockets Work**

This huge book (almost a foot high!) tells you the complete history of rocketry—its origin, the "back-yard" rocketeers of the 30's—the German V-2, and World War II's contribution. With 170 dramatic illustrations and authoritative text, it explains in simple, nontechnical terms exactly how rockets operate. Describes the Atlas, Titan, Thor, Nike, X-15, rocket airplane of the future, the Sputnik, the Vanguard, and the Explorers.

**A Glimpse of the Future**

This up-to-the-minute book looks ahead to rockets propelled by ions, nuclear energy, and even light itself; to manned satellites and space craft; and to the incredible explorations of the universe that now appear within reach.

**Examine It Free for 10 Days**

Simply mail coupon to examine book for 10 days...FREE. If not delighted with the book, return it; owe nothing. Otherwise, send only $6.75 (or easy installments, if you wish). D. Von Nostrand Co., Dept. 401, 120 Alexander St., Princeton, N. J. (Est. 1848).

D. Von Nostrand Company, Inc., Dept. 401, 120 Alexander Street, Princeton, New Jersey

Send me—for 10 days FREE examination—Rocketry AND SPACE EXPLORATION. If not delighted, I will return book; owe nothing. Otherwise, I will remit $6.75 plus small shipping cost, and $2.50 a month for 2 months.

Name ____________________________

Address __________________________

City ______ Zone ______ State ______

SAVE—Check box if enclosing full payment ($6.75) with this coupon. Then WE will pay all shipping costs. Same return for refund privilege applies.

In Canada: Address D. Von Nostrand Company Ltd., 25 Hollinger Road, Toronto 16, Canada (Price slightly higher).
G. Harry Stine is the president of the National Association of Rocketry. After receiving his degree in physics from Colorado College in 1952, he spent over five years at White Sands Missile Range, where he worked in various phases of rocketry. Later he was employed by the Martin Company at Denver as a design engineer. He was one of the first rocket enthusiasts in the nation to voice alarm at the rocket potential revealed by the Soviet artificial satellite; as a result, this action caused him to lose his position with Martin. Since that time, he has devoted his energies to the field of model rocketry. He is president and chief engineer of Model Missiles, Inc., in Denver, Colorado. Stine is a member of the American Rocket Society, a fellow of the British Interplanetary Society, a member of the American Association for the Advancement of Science, the Authors' Guild, and the Association of Lunar and Planetary Observers. As a "part-time" writer, Stine has published books, factual articles, and hundreds of science-fiction stories.

"Recovery Crew, stand by! Pad number one ready to launch!" The public address system announces the thirty-first test of the day. There is a flurry of activity in range control and tracking stations. The fire control officer inserts his key. There is a momentary hush. Then, on its tail of smoke and flame, the mighty rocket leaps skyward—all the gleaming white "14 inches" of it.

Most Americans are now familiar with the well-publicized U.S. missile and rocket test areas, the Atlantic Missile Range, the Pacific Missile Range, and the White Sands Missile Range. Rockets, missiles, Space and satellite vehicles launched from these places are probing Space and extending mankind's frontiers beyond the atmosphere. But too few people have heard of Green Mountain Proving Ground, which is just as much a gateway to tomorrow as those "hallowed" spots listed above.

Green Mountain isn't big—only 560 acres—and, in contrast to the three major missile test centers, it is located within ten miles of a major city, Denver, Colorado. It has launching pads, flight safety, optical instrumentation, communication nets, and all the other essentials of a rocket testing area. Other missile testing centers often close down over weekends, but that is the time Green Mountain gets into gear.

This diminutive rocket proving ground is used to test diminutive missiles. The largest vehicle launched there to date was 36 inches long and weighed 1 pound. The average missile fired there weighs less than 2 ounces, is about 12 inches long, and reaches an altitude of 500 to 1000 feet.

Since its founding in November 1957, over 10,000 model rockets have been flown there. And the safety record is perfect! There has not been a single accident.

This amazing safety record stands in stark contrast to the increasing number of rocket
accidents reported among amateur rocketeers over the nation. The record is even more amazing in view of the fact that Green Mountain Proving Ground is operated by teen-agers. There is adult supervision, of course, but that isn't the whole reason for the excellent safety record.

Green Mountain Proving Ground is operated under the auspices of the Mile-High Section of the National Association of Rocketry, a nonprofit organization backed by such well-known rocket experts as Willy Ley, Col. Charles M. Parkin, and Erik Bergaust. At the time of the founding of the NAR, it was realized that two things were needed among teen-age rocketeers. Safe, tested components, and a means of reaching teen-agers to disseminate information. The emergence of model rocket components in the form of small, high-thrust rocket engines and model rocket kits satisfied the first requirement. The NAR was organized to satisfy the second one.

The founders of the NAR in turn recognized the need for two elements in the informational area of the problem, two items which were totally lacking in most other amateur rocket organizations. The first of these was a set of standards or rules for the teen-age rocketeer to follow in making and launching his rockets. In essence, these standards would set limits within which the youthful designers could work. The second item was a safety code of tested rules, adopted in part from "big missile" work; this safety code would guide teen-agers within the limits of the launching and handling standards.

The safety code came first because of the need for getting this information into the hands of youngsters to stem the tide of rocket accidents.

A comprehensive set of standards was adopted later. Since model rocket components were now commercially available, these standards also included competition rules which allowed youngsters to measure their own progress and achievement against those of others within a standardized framework.

These things were not original concepts. They were borrowed outright from model airplane enthusiasts, who under the safety rules and competition regulations of the Academy of Model Aeronautics, have progressed at an amazing rate with a reputable safety record of their own.

The reasons for the safety record of Green Mountain Proving Ground lie in the Safety Code and the standards of the NAR. Green Mountain has worked from the beginning—even before the rules were written, because the rules were tested there.
Although the NAR is a young organization, there is so much to tell about it that a whole magazine could be devoted to it. In fact, NAR publishes its own monthly newsletter The Model Rocketeer, which is sent to all members and contains news items, contest announcements, a question-and-answer section, and other items of interest. NAR also publishes "NAR Technical Reports"; examples of the contents are illustrated by some of the titles of the NAR Tech Reports: "Basic Rocket Trajectory Calculations," "Building a Range Firing Panel and Communications System," and "Project Eyeball, An Optical Tracking System."

NAR has also established model rocket flight operations areas at locations other than Green Mountain. Peak City Proving Ground in Colorado Springs, for example, was set up by NAR members on land donated by the 

John Wong, Jr., of Denver, Colorado prepares a model for flight at Green Mountain Proving Ground. Note the various configurations, including scale models of the "big ones". (Photo by Katzell)

parks department of that city as a result of a city ordinance sponsored by NAR. Peak City operates along the same lines as Green Mountain, and boasts a perfect safety record, too.

In the educational field, NAR has helped schools set up rocketry divisions for their science clubs. In Littleton, Colorado, where such a program is in operation, two NAR members this year won top honors for their work in developing a micro-miniaturized rocket telemetry system (FM-AM, 8 channels, 1 ½ inches in diameter, 4 ounces, 12 inches long, 100 mw output on 27.25 mc.) complete with ground equipment.

This spring, NAR started its first contest season, to culminate in the NARAM-1 (NAR Annual Meet #1) at Green Mountain Proving Ground in July.

All this started at Green Mountain Proving Ground, and Green Mountain is still the top range in the NAR. But what has it done besides proving that model rocketry under NAR sanction can be safe? An answer to this question may be found in the young men who built Green Mountain.

Several of them will be starting college in the fall of 1959; they know and understand rocketry now, and they plan to make astronautics their career. Others are still a long way from college, but they understand research and development; they can sit down and plan a flight test program, for example, and carry it through. They have learned optics, meteorology, aerodynamics, electronics, thermodynamics, and basic scientific disciplines—not from books, but from actual experience. They have supplemented their mathematics by putting it to practical use.

There is no doubt that ultimately the careers of young men are strongly influenced by experiences during their formative years. Green Mountain Proving Ground has given its participants experience in the field of rocketry. It is quite likely that they will eventually stand high in their chosen profession; after all, they have a head start.

Let's take a look at a typical day at Green Mountain. All the range equipment is portable and is stored in Denver during the week. A half-mile of communication cable was once stolen from Green Mountain, so range par-
Participants don’t take chances any more. Rocketeers meet at a rendezvous point in Denver at 9:00 A.M. on Saturday morning. There are usually two, and sometimes three, station wagons loaded with gear. Then the caravan takes off for Green Mountain, easily accessible by four-lane highway and paved roads, but still a good way out.

Upon arrival at the range, the communications crew starts stringing out the communications wire from a back-pack cable reel, donated by an oil survey firm. The instrumentation crew sets up, levels out, and “zeros in” the tracking telescopes. The launcher crew sets up launchers, plugs in the firing panel, and checks out the public address system.

Everyone then starts preparing his models. If a model utilizes a rocket engine other than a tested commercial type, it is removed to the isolated Hazardous Test Pad, 100 yards from other operations and equipment. It will be launched at some time during the day by a trained crew under adult supervision and by remote electrical control.

The launching pads at Green Mountain are unused, concrete foundations of ammunition magazines, 25 feet wide and 45 feet long. They stand about 4 feet above the ground and have stairways at either end. No blackhouse is needed; during hazardous tests, everyone stands behind a foundation. Nothing is ever fired which would require overhead protection. Since all NAR rockets require a system which destroys the aerodynamic stability before they come down and since all models flown are extremely light, it’s better to be out in the open where you can just step to one side if one comes down your way.

Eight launchers are usually set up on the main pad. If there are more rockets to be flown during the day than can be launched from a single eight-launcher pad, a second pad is set up on another foundation. But, since it is possible to fly and track 50 models per hour at Green Mountain, two pads are rarely needed.

All firing is done by remote electrical control. All firing panels have safety circuits which include keys, guarded switches, firing lines shorted until the switch is thrown, and other interlocks.

Each model ready to be launched is placed on the ready pad atop a flight-test data sheet. This sheet lists the designer of the model, type of engine it has, and other technical details. The launching officer picks up the model and its sheet, places the model on a launcher, and notes the launcher number on the sheet. This keeps the fire control officer from getting confused later on.

Once all launchers are loaded, the call goes out over the PA system, “Trackers, man your stations! Recovery crew, stand by! Pad Number One ready to launch!”

The boys manning the telescopic tracking stations report in by telephone.
“Tracking One manned!”
“Tracking Two manned!”

The range control point is usually next to the firing panel at Pad #1. The range safety and control officer, an adult, takes his station and removes the firing panel key from his pocket. “Trackers ready?”
“Tracking One ready!”
“Tracking Two ready!”

“Trackers ready!” reports the fire control officer. First missile is from Launcher One, a gleaming white model of the Jupiter IRBM.
A scale-model of the US Navy ASP rocket swishes aloft from Pad #1 of Green Mountain Proving Ground. All launching is done on a countdown by remote electrical control. Note the range flag on the right and the anemometer tower on the left. (Photo by Katzell)

The safety officer scans the area. No one is in a place where he could be injured. No cars are coming up the access road. There are no aircraft in the vicinity. Everything is ready, and everyone is waiting. The safety officer inserts his key into the arming panel and turns it. "Range is clear! Panel is armed!"

All conversation over the communications net is heard in the launching area over the PA system. The fire control officer throws the launcher selector switch. The countdown begins.

At zero-time, the little model leaps off the launcher and rockets skyward. All eyes follow it. Trackers swing their instruments to stay on it—a difficult job with the 14-inch model boosting at 8 G's. At peak altitude, the recovery system activates, and trackers lock their scopes. The missile drops to Earth.

The recovery crew goes into action, chasing down the model to bring it in to be prepared for another flight; under NAR rules, all models must be capable of more than a single flight.

The tracking stations report in, calling off the azimuth and elevation of the model at peak altitude as seen from their stations. Two stations are always used, with more as backup if required. They are on carefully measured baselines, surveyed by the boys. The angular information is recorded on the flight data sheet, along with weather data, such as wind direction, wind velocity, cloud coverage, temperature, humidity, and barometric pressure. The sheet is then passed to the data reduction crew who stand by with slide rules, trigonometric tables, and other calculators, ready to reduce the tracking data to altitude information.

Meanwhile, other models soar up into the sky. Staged models are flown, as well as models with clustered, solid propellant motors. Many experimental flights are carefully documented with motion picture cameras; the film is later scrutinized frame-by-frame to examine performance.

Although the boys have gotten their staged models up well over a mile, such an altitude is an unusual one in spite of the generally high reliability of the models. Since the safety criteria developed for Green Mountain places...
on altitude limit of 6000 feet on models launched there, the NAR members have emphasized achievements other than altitude.

One of the most interesting activities is a payload competition. The NAR has developed a standard payload, consisting of a cylinder of lead 3⁄4" in diameter and about 7⁄8" long, weighing one ounce. The object of the competitive effort is to carry this payload to as high an altitude as possible with an engine of a given thrust and duration. The payload must be totally contained in the model, must be removable from the model, and must not separate from the model in flight. Careful design pays off in this event, which very closely duplicates the requirements of real rocketry.

By limiting maximum altitudes through motor limitations, a great deal of interest is generated in scale model work. Where else could one find the following missiles being launched from the same pad on the same day: V-2, Little John, Jupiter, Jupiter-C, Thor-Able, Asp, Pogo-Hi, Arcas, Redstone, Sergeant, and Sidewinder? Careful research goes into these scale models, some of which have each rivet and weld line of the real thing.

Many original designs show up each Saturday, too. Before allowing models of unproved design to be fired, the safety officer must be convinced by design data that they are safe and stable in flight. Some strange birds have appeared at Green Mountain. Give a boy any hobby-type rocket engine that works, plus some basic design information, and he'll have no end of designs. However, he soon learns which ones work—and, more importantly, at Green Mountain he learns why.

Green Mountain Proving Ground is probably as important to the nation as the "big missile" ranges. The same holds true of Peak City Proving Ground and the other NAR flight ranges. Today's missiles are being tested by today's engineers at Canaveral, Vandenberg, and White Sands. But at Green Mountain, tomorrow's missiles and Space vehicles are being born in the minds of tomorrow's Spacemen. It's being done in a manner which brings to life the NAR motto: "Safety, Knowledge, Enjoyment."

The first man to walk on Mars is possibly flying his model rocket on some NAR proving ground today. Green Mountain was the first. It is truly a gateway to tomorrow.

Editor's Note: Many readers will want to start their own rocket clubs. If you are interested in further information on this subject, the National Association of Rocketry is waiting to help. The NAR is also ready and willing to assist science teachers who are eager to incorporate rocketry into their curricula. If you want to communicate with the NAR, Write to Rocket Club, P. O. Box 94, Nashville, Tennessee. We will forward your communication to NAR.
THE FUTURE IS A WIDE OPEN FIELD IN WHICH ANY IDEA WITHIN THE REALM OF PRESENT DAY IMAGINATION CAN BECOME REALITY. WHAT TODAY IS ASTOUNDING, WILL TOMORROW BE COMMONPLACE.

HOWEVER, FREDDY FUTUREMAN IS NOT THE HANDSOME, RUGGED FEARLESS HERO TYPICAL OF TODAY'S SCIENCE-FICTION STRIPS, BENT ON DISCOVERING AND EXPLORING NEW WORLDS. HE IS SIMPLY "MR. AVERAGE GUY", LIVING IN THE AMAZING, BEWILDERING WORLD OF TOMORROW. HIS IS THE FAMILY OF THE FUTURE, AND THE STRIP PRIMARILY IS CONCERNED WITH THE DAY-TO-DAY ACTIVITIES OF SUCH A FAMILY.

BASICALLY, THIS IS A "FAMILY" STRIP, SET AGAINST THE BACKGROUND OF THINGS TO COME........
READY TO VISIT THE MURKELS?

TURN ON YOUR COPTER-PELLER AND LET'S GO!

SARAH, GUESS WHO JUST DROPPED IN.

EEEK! FREDDY! COME QUICK!

WHAT'S THE MATTER?

WINDOW PEAPEER!

GOSH, FRAN, HE'S NO WINDOW PEEPER.

JACK, YOU MUST GET VERY LONELY, RUNNING A HOT DOG STAND WAY OUT ON MARS.

OH, IT'S NOT THE LONELINESS THAT'S GETTING ME DOWN....

IT'S THIS DARN COMMUTING!

I'M FROM PLUTO... INVADERS!

...DOG FOOD COMPANY.
Dear Editor,

I read your spring issue of SPACE Journal and was very pleased with it. I thought it had to be good because it was written by such outstanding authors and scientists. Of special interest to me is the article "Life on Other Stars." I read it thoroughly, not understanding half of it; but some of it made sense. I have read other books on this project, but I'm still not convinced about it either way. According to this article there is some form of life on about 100,000 different planets. As a boy of 14 I have read a lot of books on this subject, but I still am confused. I hope you can help me. I can see why there could not be life on Venus or Mars. No one has discussed these problems. In the case of Venus, it is too close to the Sun to support life. While in the case of Mars, it is too far away from the Sun to support life. . . . What do you think about the flying saucer conspiracy?

Syracuse, N.Y. John Palermo

Sooner or later all deeply involved and complex scientific investigations into cosmography turn to philosophy for answers. For example, what do you mean when you say "life?" Are you thinking of life in anthropoid terms or in bio-chemical terms? As you know, scientists now are somewhat puzzled by the behavior of certain large molecules—they appear to be living. So the answer to your first question hinges on what you mean by life. To the scientist the amoeba, the lowest and most primitive form of moss, and man are all alive. All evidence points toward the fact that certain low types of vegetation exist on Mars. Therefore, life on Mars is probable—if you accept the scientific view of life. The theologian would probably insist that life, within a more parochial sense, consists of three kinds: vegetable, animal, and man, the distinguishing factor between animal and man being the soul. Even so, he would recognize vegetation as a form of life. So from either view, life on other planets seems probable. As for the flying saucer conspiracy, it sounds romantic and exotic, but there is no reason to assume that they either exist or that they are from Outer Space.

Editor.

Dear Editor,

I would like to express my appreciation for the many fine articles which have appeared in your magazine. The vision, and farsightedness of your many contributors is most refreshing and sets an example for other magazines to follow.

In brief, Mr. Thomas believes in a corpuscular theory of light and feels that the velocity of light is not constant for all observers. Rather, he thinks, the observed velocity would depend on the relative velocity between the light source and the observer. Editor.

Dear Editor,

I believe it would add to your usefulness and increase your circulation if you added an "original" section for independent thinkers on scientific subjects (laymen preferred.)

Many subscribers, like myself, have original thoughts which if published might be amusing in the main, but a small percentage might be diamonds in the rough for the over-wrought men in whose charge lies the responsibility for the progress of the United States in Space. . . .

Somerset, Mass. James A. Daniels

Without deprecating the validity of Mr. Daniels' suggestion, SPACE Journal must defer.

We recognize that the sharp-rowelled imaginations of lay writers in all ages have spurred the mount of science into new and unexplored fields, and, perhaps, have often predestined scientific advances by foretelling them. However, in today's complex, specialized world of science even the scientists themselves have difficulty in communicating with one another when they are in different fields. Therefore, we feel that there is a need for the scientists in various fields, especially those related to Space travel, to tell each other and the layman what is and what is going to be—this as opposed to the layman telling the scientists. Perhaps the Space-roving scientist has over-
Dear Editor,

As a writer caught up in a consuming interest in Space and the fantastic ramifications of our rapidly expanding knowledge of our Universe, I would like to join the discussion regarding the inclusion of science fiction and poetry in SPACE Journal.

The historical function of the artist, and that includes the writer, has been to interpret and present the Universe in such terms as to enhance the understanding and enjoyment of the reader or beholder. At a time when the layman is disturbed by the presentation to him of a Universe of such scope and size that it staggers his comprehension, the role of the writer/artist has achieved an importance unequalled in history.

SPACE Journal should not lose sight of its objectives by devoting its pages solely to scientific analysis. A famous scientist (name sent free upon request) once remarked: "The difference between a scientist and an engineer is that a scientist reads poetry." This statement was not made lightly; and, at least as far as most domestic engineers are concerned, it seems true. That truth is revealed as much in fiction and poetry as in the logarithmic tables and learned journals is not denied. But the cynical may point out that Pilate asked, "What is truth?" Well, the truth is that our readers, by and large, do not want fiction in the magazine. The majority of them say that when they want to read space fiction they will buy a book by Roy Bradbury or Arthur Clarke. However, we have been sneaking in a little poetry on the off chance that some engineer might read it and remark: "Say, you know that makes sense, even though it does rhyme." Associate Editor.

Start with the next issue

SPACE Journal. Become a regular subscriber. Read the only magazine that covers the field of space completely. Written in language understood by the layman as well as the scientist and engineer.

Fill out the enclosed card and send it in today.
The International Astronautical Federation has set up a committee to define air and Space jurisdiction and to formulate rules on such jurisdictions. The committee is headed by Professor John Cobb Cooper, an internationally known lawyer, and is composed of members from all nations in the federation. It will submit its findings and recommendations to the Secretary General of the United Nations.

Recent observations made with the Mt. Palomar 200-inch telescope indicate that the rate of expansion of the Universe may be decreasing at the outer extremities of Space. Spectral studies indicate that the farthest observable galaxies are speeding outward at about 1/3 the speed of light. If the Universe were expanding uniformly, the rates of recession of these systems would be greater.

The National Association of Rocketry plans to hold its first annual meeting in Denver, Colorado. The four-day event will begin on 16 July and will utilize the facilities of the association's 560-acre Green Mountain Proving Ground, a fully instrumented range for use of the association's members. Approximately 20 different model rocket competitions are scheduled.

Mrs. Robert H. Goddard (right) cuts the ribbon at the formal dedication of the Goddard Wing of the Roswell Museum during ceremonies at Roswell, New Mexico on April 25. Mrs. Goddard is the widow of the late Dr. Goddard to whom the Wing is dedicated. Robert Goddard (1882-1945), Massachusetts-born physicist, successfully conducted some of his early experiments near Roswell. He achieved many "firsts" in rocket research, any one of which would assure him of the title "Father of Modern Rocketry." Looking on are Dr. Wernher von Braun (left) and Army Under Secretary Hugh Milton. (John Foster, Roswell Daily Record)
The General Electric Company recently completed a mock-up of a Space capsule which could carry a man into outer Space. It is presumed that the capsules could be used with existing guided missiles. The interior of one design has been fitted to the contours of the pilot himself. In the view shown below, the pilot’s seat and instrument panel are illustrated. The aft end cover of the capsule has been removed to show details.

Professor Hermann Oberth, the “Father of German Rocketry,” recently arrived in Germany after four years of service with the Army Ballistic Missile Agency in the United States. He has been awarded a pension by the German government. Upon his arrival in Nurnberg, he was greeted by members of the German Rocket Society. In press interviews he stated that he plans to continue his theoretical studies in Space travel and to complete a book on the philosophical aspects of life. He also commented favorably on SPACE Journal and cited it as an excellent magazine dealing with the Age of Space.

France

The Association for the Advancement of Aeronautical Research (a French organization) will hold its second international congress on rockets and intercontinental connections in Paris during June. Papers on hyperballistic techniques in aerophysical research, design of manual control systems for Space vehicles, turbulent re-entry heat rate predictions, and other subjects will be presented.

A plan to observe Venus from a position 82,000 feet above Earth’s surface has been formulated by Audouin Dollfus, a young French scholar and authority on Mars. His ingenious observatory consists of a magnesium and aluminum capsule, equipped with a telescope, a spectroscope, and other instruments, attached to a group of 96 balloons, of the type used in meteorological investigations. His first attempt in May was a partial success.

Poland

The Polish Astronautical Society reported a rising membership and a growing interest in astronautics at its annual conference last May in Warsaw. Papers were presented on rocket propulsion and fuels, aeroballistics, guidance and automation, methodic research planning, Space travel, and Space biology and medicine.

Russia

Professor V. S. Gostev, of the Academy of Medical Sciences, states that the Soviet Union has produced and is testing a number of drugs for human beings travelling in Space. He told the newspaper Medical Worker that Space travellers probably will need sedatives, drugs to stimulate circulation, and preparations affecting lung and skin respiration.

A recent Russian report that a volcanic eruption had occurred in the Alphonsus Crater of the Moon brought mixed reactions from leading astronomers. Most scientists have long believed that the Moon’s craters were made by the impact of meteors. However, Dr. Dismore Alter, former director of the Griffith Observatory, has made an observation that tends to confirm the Russian finding. Dr. Alter reports the presence of “seeping gases” and an obscuration on the western side of the 70-mile-wide floor of the Alphonsus Crater.
Russia

★ On May 1, 1959, the London Times published the following Reuter News dispatch: "Moscow, May 1.—Dr. I. Shklovsky, a Soviet scientist, said in an article in Komsomolskaya Pravda quoted by the Tass agency today that no methods found in nature could explain either the origin of the two moons of Mars, Phobos and Demios, or the strange movement of Phobos. He suggested that they might be artificial satellites put into orbit by intelligent beings who might have inhabited Mars 2,000 or 3,000 million years ago.

Dr. Shklovsky said that Phobos and Demios differed from the satellites of other planets by their insignificant size and their extreme closeness to their planet. Phobos, moreover, showed another striking dissimilarity from all other satellites in the Solar System in that it had deviated in the past few decades from its calculated orbit by two and a half degrees, and its movement had accelerated. This meant it had gone closer to the surface of Mars.

"The same thing happens to satellites launched from the Earth; they are slowed down by the resistance of the Earth's atmosphere and consequently come down and in doing so accelerate," Dr. Shklovsky said. He had concluded that Phobos was hollow, and that as no natural body can be hollow, it must be an artificial satellite of Mars. He suggested that Demios might have had a similar origin.

Though they might weigh 100 million tons or more, their construction would present no insoluble engineering problems for beings endowed with intelligence. At present the atmosphere of Mars contains almost no oxygen and consequently there might no longer be any highly developed life on Mars. But apparently 2,000 or 3,000 million years ago the situation was different. Many astronomers consider that there was then oxygen in the atmosphere surrounding Mars. Probably in that period there were on Mars beings endowed with intelligence which attained a high degree of culture.

Another Soviet scientist, Prof. Aleksander Kazancew, believes there is mounting evidence that there is today intelligent life on Mars. He theorizes that the tremendous explosion in Siberia 50 years ago which destroyed several square miles of timber was caused by the crash of a nuclear-powered Spaceship.

★ For the Russian man in the street, there is a new means of getting rid of "that five o'clock shadow"—provided he has the rubles—the latest thing in electric shavers: a model named Sputnik.

★ A one-stage rocket, reported to have been launched in August 1958, carried two well-trained dogs to an altitude of 450 kilometers. The total payload is supposed to have been 1½ tons. According to the Russian news sources both dogs were recovered and apparently suffered no ill effects from their journey into Space.

★ It is reported that the Russians now have on the drawing boards plans for a Space vehicle with a velocity of 17 kilometers per second. It is a two-stage rocket said to be able to reach Mars in only three months.

East Germany

★ The East German magazine Wissen und Leben (Knowledge and Life) states that during 1957 the Russians sent 12 dogs into the atmosphere in rockets which went up to 120 miles. These tests made it possible to send Laika up more than 1000 miles in Sputnik II.

★ Reports indicate that the Soviet Union has more than 66 tracking stations within her own territory for gathering data on the Sputniks. These stations are primarily at universities and technical schools, and are manned on a volunteer basis.
Reviewed by Ralph E. Jennings
Curtis E. Ramey
M. Raymond


The Select Committee on Astronautics and Space Exploration of the House of Representatives has devoted considerable effort to publication of a "Survey of Space Law." The clarity of discussion is commendable in view of the complexity of the subject. This survey presents a strong argument to the pragmatists who take the position that promulgation of a Space code should follow the actual occurrence of de facto regulatory problems. Unless we reverse the traditional concepts of law evolving with life and dealing with problems after they have arisen, it is quite likely that we shall be faced with "the giddy cycle of law chasing power and never quite catching up," a possibly fatal position to occupy in Outer Space. It seems to this reviewer that necessity dictates our having a considerable body of Space law thinking available at the time power to regulate and enforce becomes a reality. The Darwinian concepts of "struggle for existence" and "survival of the fittest" are not wholly inappropriate here. The survey treats both ancient and relatively new legal doctrines which might possibly have some utility in guiding present-day thinking on Space law, i.e. "cuius est solum, eius est usque ad coelum" (he who owns the land owns it up to the sky), Mare Liberum (Law of the Sea), Res Ipsa Loquitur (The thing speaks for itself), etc. The survey also discusses the doctrine of "sovereignty" with its many ramifications. The concepts are admittedly "groping posts" for some framework of reference and may have little or no place in effective Space law codes but must be presently resorted to because of our limited knowledge of conditions to be encountered in Outer Space.

It is refreshing and somewhat comforting to see that we and our Congress somehow appreciate the magnitude of the problems we shall eventually face in Outer Space and are devoting intensive thought to anticipating and compromising the expected problems.

It seems terribly important that we do so. For if we merely project present international conflicts upon the larger screen of the cosmos, the human family will undoubtedly face its gravest danger since the dawn of creation. This reviewer heartily recommends the serious reading of this survey by all people but especially by scientists, lawyers and statesmen.

-Curtis E. Ramey


Certainly one of the most attractive features of this book is its price. In this age of high publishing costs, it is rare indeed to find a worthwhile book for $3.00. And it is even more rare when the book is as worthwhile as this one.

Price notwithstanding, the best feature of the book is the evident sincerity and objectivity with which the author wrote it. He believes—most convincingly—that life does exist on Mars. And it is hard to refute him, for he defines life in the most exacting and scientific terms. Life, for the author, is rather a deterministic bio-chemical complex. If the reader is willing to accept this view, then the rest of the book follows a neat and logical
order. In other words, the difference between man, moss, and microbe is quantitative rather than qualitative. Thus the lowest lichen clinging to a rock is as alive as the man who crushes it under foot as he walks. So, too, the microscopic germ that in the end falls man.

Much of this informative book is given over to the ecological aspects of life on Mars. For this reason the first four chapters will be especially interesting to those readers of SPACE Journal who were stimulated by John Hulley's widely acclaimed article "The Purpose of Man in the Universe" (Summer, 1958). Particularly noteworthy in this respect is the chapter titled "What Is Life?"

But the real value of this book lies in the fact that it sums up what is known about Mars in a language which the average or general reader can understand. Recondite (Dealing with what is abstract; characterized by profound scholarship) words and terms are always defined for the nontechnical and nonprofessional reader. —M. Raymond

The third edition of Van Nostrand's Scientific Encyclopedia is a superb reference book. Covering everything from aeronautics and astronomy to statistics and zoology, this handsome one volume edition contains over 2,000,000 words, 100,000 definitions, 14,000 separate articles, and 1400 illustrations. Twelve pages are in full color. Never was it more important to have available for fingertip use a single volume that offers a reliable, understandable guide to science in the Space Age. This new edition, bringing together between one set of covers the equivalent of a multi-volume science library, is a book to be kept on the shelf with the few basic volumes that are used everywhere for essential day-to-day reference. The world of modern science has in the past decade progressed swiftly across hitherto impassable barriers. It has penetrated every phase of life. It is impossible for the layman (or scientist, for that matter) to keep abreast of developments in all fields. This encyclopedia would be an exceptionally valuable addition to anyone's library. —Ralph E. Jennings

Here's a full scientific report on space flight—its past, present...and future!

SPACE FLIGHT

Satellites, Spaceships, Space Stations and Space Travel

By CARSBIE C. ADAMS

President, National Research and Development Corporation, Atlanta, Georgia

NOW—the exciting and factual account of what is involved in space flight—and how our scientists and engineers are bringing us into this new era—is given by experts.

From man's earliest skyward thoughts to today's ACTUAL plans for flight in space...the men, discoveries, and technological advances responsible are now brought before you in a striking review.

The treatment is soundly technical, fully annotated, and fascinating in its portrayal of far-reaching concepts and the growth of the means of their realization. Here is an integrated picture of the ways in which the many fields that lend their knowledge to astronautics are working together to make space flight a reality. You learn about the contributions made by:

---aerophysics ---communications ---geophysics ---psychology

---chemistry ---materials ---space medicine ---and other fields

Dr. Wernher von Braun says of the book in his preface, "I am certain that it will soon attain the stature of one of the few great classics on this fascinating and many-faceted subject. It thoroughly covers the theories, methods, equipment, and pivotal scientific and human factors—various development of practical space flight.

Free Ten-day Examination


Send me Adams' SPACE FLIGHT for 10 days examination on approval. In 10 days I will remit $6.50, plus 50c delivery, or return book postpaid. (We pay delivery if you remit with this coupon—same return privilege.)

For prices outside U.S., write McGraw-Hill Int'l., N. Y.

Name__________________________  Address__________________________

City, Zone, State__________________ Company__________________________

Position__________________________  SJ-69-1
is time the missing link?

PART 1—DISPLACEMENT ENERGY

by Helmut Hoeppner and
B. Spencer Isbell

The answer, which is neither new nor obviously indicative of any new way to go, was given by Albert Einstein when he said: "The answers to most, if not to all, of the unknowns in science can be found by the formulation and derivation of the knowns into their correct relationships."

This sounds rather disappointing instead of encouraging, when we consider our intense, enthusiastic, and persistent efforts in research; our studies, developments, and technical achievements.

"I studied Philosophy and Law and Medicine, too, and also Theology, but here I am standing now, a poor fool, not wiser than before."

—Faust (Goethe)

We are turning out more and more and bigger and bigger progress reports, articles, books, and more speeches at more meetings, conferences, symposiums, etc. And the results of our "progress"? Nothing fundamentally new, just more quantity, more paper to file, more words. Quantity is already replacing quality in science, in philosophy, in society, and even in our way of life.

What is wrong? Is Einstein's statement, about deriving the unknowns from the knowns, wrong? Should we look for more new phenomena? If new postulates and laws could
WHAT IS NOT FULLY UNDERSTOOD IS NOT POSSESSED

GOETHE
not be derived from the known ones, we would have to wait until by accident we could stumble upon a new discovery—just by continuing or increasing our statistical efforts. Then we really would be caught in a dilemma. The probability that our already intense efforts in quantitative research will accidentally discover a new phenomenon which will provide the missing link in our over-all physics picture is far from encouraging. For example, we already have quite a number (32) of elementary nuclear particles which show, or do not show, individual characteristics; but which, nevertheless, cannot be combined into one acceptable picture. The discovery of additional new particles would only complicate and add to the present state of confusion in nuclear physics.

Very often, in scientific research, the quantity and even quality of a missing link can be logically predetermined. This has been attempted in nuclear physics. When the old Law of Conservation of Energy is applied, a "particle" which has a variable quantity of energy and no mass or charge is required to satisfy the lack of energy balance (impulse input and output) in nuclear physics. This "particle" is sometimes called "neutrino". Other scientists call it a "ghost particle" because it does not really "exist", but "it shows its existence twice; namely, when it appears and when it disappears" according to a recent remark by Professor J. Robert Oppenheimer. This almost desperate search for a "ghost particle neutrino" is about to create a new type of philosophy, where anything (which in physics seems to be unexplainable) is possible and can be "explained".

Currently the newest arm of the Metaphysical Octopus is the so-called "Time Dilatation" Theory. This "fountain of youth" ideology advertises round trip Space tickets: Put $1.00 in your savings account, take off, enjoy your trip around Mars, Venus, or Centauri, and return after a year or so to Huntsville, Alabama, or any other place on Earth and you will own the whole globe. Just go fast enough and your own individual time, compared with the time on Earth, runs a hundred—or a thousand—or a million times slower. And you won't even notice this because every occurrence around you and traveling with you (including your watch), slows down in the same scale. Upon return from your "one year" in Space the accumulated interest on your $1.00 bank investment will have consumed all the money on Earth. Just go fast enough!

But before you contact your travel agent about a "Round Trip Space Ticket", let us analyze the third question at the beginning of this article: namely: "Should we re-examine the adequacy of our scientific methods and tools?" With all due respect to mathematics and to the great mathematicians whom we sincerely admire, we must place mathematics in a secondary position to pure logic as a necessary tool or method for "deriving and
formulating of the knowns into their correct relationships”.

Mathematics must be logical, but it is not in itself “The Logic’ and it cannot replace “The Logic”. We can only use mathematics as stenographers use shorthand, to formulate logical realtionships within the limits dictated by the initial input of assumptions and reason. The validity of mathematically derived results is relative to the value of the input. The limitations of mathematics were once clearly illustrated to the authors by one of the pioneers of astronautics, Professor Hermann Oberth, when he remarked: “Mathematics also proves that when three persons are in one room and four persons leave that room, then a negative (or minus one) person is still in the room”.

Sir Arthur Eddington indicated the need to re-evaluate our scientific methods in his “The Philosophy of Physical Science” (1939) with the following remarks: “If sometime someone would claim that he produces neutrinos, I just would have to accept this. But I always would doubt that he plays a fair game. He would not be punished for producing neutrinos, namely: For having violated the fundamental rules. He simply invented a new game by changing the rules, which, when accepted, helped to overcome a dilemma”.

The answer to the question about the adequacy of our scientific methods and tools is: No, they are not adequate! We must re-evaluate our fundamental assumptions.

The scientific dilemma is further complicated by an unhealthy condition which is entirely unscientific, even anti-scientific, and therefore, difficult to solve. This condition stems from a division of the scientists of today into at least two categories according to the methods and tools they prefer to use for solving scientific problems.

The majority of scientists (and not only scientists) paid their tuition for what they carried home from their schools in “black on white”. They bought all their scientific equipment, all their methods and tools from their universities. And since they spent money for it, they keep it neat and clean and dogmatically protect it against change.

In the other category, and unfortunately it seems to be a small minority, are those who forgot most of the “pure” knowledge they learned in school, and who paid their tuition to learn that there are no cook books, no fixed methods, and no rigid laws and tools which guarantee scientific progress.

The majority considers science to be a dogmatic combination of the whole knowledge and scientists as persons who know very much (sometimes everything!). For the minority, science, according to Socrates, is the total of what we do not know. All the scientific equipment the minority has from its schools of higher education, is its awakened and educated intelligence, and scientific enthusiasm. However, in spite of, or perhaps because of, its expulsion from the majority, the scientific discipline of a few honest non-conformists who apply reason and logic before mathematics has always “moved the Earth.”

In order to demonstrate the value of taking an open-minded “second look” at our rigid scientific laws, methods and tools, and to illustrate why it is not necessary that science must resort to abstract philosophy for the answers; let us momentarily go back 100 years to one of the greatest discoveries in the history of science. At that time Helmholtz formulated the Law of Conservation of Energy, which, as any “law” in physics, is an empirical law. Only a little later, Clausius introduced the concept of “Entropy” and Maxwell formulated “Displacement Current” as two kinds of restrictions to the energy law.

The Law of Conservation of Energy says, simply, that energy cannot be created or destroyed. In other words, the sum total of energy in any transformation or transfer remains constant. You can throw a ball and give it kinetic energy, but you do not create the energy. All you do is transfer it from your body to the ball. This law is based upon a constant energy and a state of equilibrium or balance.

Entropy is the scientific term for the “availability of energy.” The relation of entropy to conservation of energy extends all the way to the basic scientific question of whether the Universe is an infinite environment which allows us to use up our total initial energy or only part of it, according to a final dynamic or even static equilibrium, which would be the
final state of a finite Universe. In any case, finite or infinite Universe, or finite Universe with another finite or infinite environment (transcendence), we are continuously consuming our "potential". And entropy, the availability of energy, determines the time for the universal occurrence. Actually, entropy can be defined as the consumption of time, or "time", itself."

In a closed system such as a finite Universe with an internal and initial "potential" and a finite environment or the theoretical model of a system shown in Figure 1-A loses its internal potential while the system is delivering work (energy), because of the non-reciprocal process of mixing or leveling.

The loss of internal potential or "available" energy in a closed system is due to the time or period the system allows for the mixing or leveling to occur. In other words, the universal tendency of matter or energy to mix or level is limited by the time it takes in a closed system. When the balance in both the "transmitter" and the "receiver" sides of a closed system is reached, the delivery of work stops and a state of equilibrium exists.

Since all practical systems are closed systems and since all closed systems lose their

*Part II of this article, appearing in the next issue of SPACE Journal, discusses "time" as the fundamental parameter in physics and explains how it has been incorrectly applied in the current scientific debate over the "Time Dilatation Theory".

potentials and available energy in accordance with the consumption of time or entropy, then the delivery of work eventually stops and a state of balance or equilibrium exists. This is the reason why it is impossible for man to create a perpetual motion machine.

This shows that a closed system fundamentally cannot actually deliver the total initial energy capacity. The amount of work a system can deliver, or the amount of energy that is "available" from a system, depends on the receiving capacity of the receiver part of the system. It is evident that only by opening our system to an environment of infinite receiving capacity or, in other words, by providing an exchange between a specific system and an infinite environment (Figure 1-B) the total initial energy capacity is also the actual "available" energy.

The second classical restriction of the Law of Conservation of Energy, was discovered by Maxwell in the field of Electrodynamics. He found that the conventional equations which equilibrium did actually prove that there were based on constant energy and a state of no electric current. Yet, Maxwell knew that electric currents do exist, so he added a fundamental parameter* to the Conservation of Energy Law and called it "Displacement Current" in Electrodynamics.

*Maxwell wrote the electric current balance as follows: $H = E_0 (equilibrium) + i_1 (displacement current)$

(Reproduced with permission from SPACE Journal, vol. 2, no. 1, September 1959)
In addition to the two classical restrictions to the Energy Law, the authors recently introduced an analogy to "Displacement Current" into the field of Astrodynamics. The new parameter, called "Displacement Energy", is also a "time" parameter since it is the energy required to move, redistribute, or displace pure energy during an occurrence (state of non-equilibrium).

The formulation of displacement energy in Astrodynamics "brought home" to the authors the importance of the primary position that "The Logic" behind mathematics holds.

The following considerations summarize the reasoning necessary before a mathematical derivation could lead to the confirmation of Displacement Energy in Astronautics. And, as we will discuss further on in this article, these initial thoughts may lead to a confirmation of our belief that "time" is the missing link to a Unified Field Theory.

1. "Displacing" is an occurrence for which "Time" cannot become zero. The criteria, or even the definition of occurrence is "Change" or "Redistribution" or "Displacement" or "Time".

2. In order to establish an orbit at an altitude around the Earth there are only two possibilities. Either two instantaneous "shots" are required; namely, one shot at the Earth's surface and the second shot at orbital altitude. Or, one continuously powered ascent with attitude control to the orbital altitude. This is simply because any unpinned motion in the gravitational field is a "free fall", which—when below escape velocity—falls back through the point of the last power cut-off.

3. It is self-explanatory that the (above) required two shots cannot, for the same mission, be combined into one shot, because shot No. 1 and shot No. 2 must be separated by a time element, which must be greater than zero.

4. Any approaches to an infinite Specific Impulse and a Mass Ratio of ONE are not applicable in any determination of a performance, simply because this would mean the undeterminable approach of zero times infinity, which is a "point" where no law or any law is applicable.

5. "Energy" which is required for a specific operation, must be, or must be made available, not only at the time but also at the "location" of the planned operation.

6. "Energy" in general mechanics is connected with mass; and also in relativistics, Energy has the property of mass, namely: Inertia.
7. For placing a unit mass \((m)\) into orbit around the earth at an altitude \((h)\), the following energies are required (as shown in Figure No. 2).

a. "Potential Energy" \((E_p)\) for placing or lifting the mass into altitude \((h)\). This \(E_p\) is required at the Earth's surface.

b. "Kinetic Energy" \((E_k)\) for accelerating the mass into orbital velocity \((V)\). This \(E_k\) is required at orbital altitude.

c. "Displacement Energy" \((\Delta E)\) for transporting, lifting or "displacing" of the Kinetic Energy \((E_k)\) from the Earth's surface to orbital altitude.

d. The sum \((\Sigma)\) of the total Energy requirement for placing a unit mass into orbit is therefore:

\[ \Sigma E = E_p + E_k + \Delta E \]

With the above considerations and assumptions, it is possible to enter mathematical derivations* which, in a routine procedure, give the quality and quantity of the three required Energy terms. The mathematical equations and the Astronautical characteristics (see Figure No. 3) show the remarkable fact that displacement energy is a pure function of the gravity field because the equations contain only distance relationships \(\left(\frac{h}{R}\right)\) and two constant factors, the radius \((R)\) and the gravity acceleration on a body's surface \((g)\). The equations are universally valid for any celestial body and for any center mass with a distance-square field distribution. (See Figure 4.)

We learned in school the old Law of Conservation of Energy, which says that within a closed system, with no exchange with the environment, the total Energy content remains constant, no matter what occurs within the system. Occurrences within a closed system are Energy Transformations, e.g. potential into kinetic energy, or in reversed procedures, etc. No Energy can be produced or consumed (cancelled); Energy can only be transformed.

The Law of Conservation of Energy is, because of its simplicity, very convenient and easy to understand and it also simplifies the mathematical derivations in all fields of physics. Since it also leads, in most practical cases, to satisfying results, no one has ever desired a change as long as the results were acceptable. However, three changes, or at least restrictions, have already been introduced, but they were not defined as changes of the energy law. They are conveniently handled separately from the energy law and they are considered to be additional parameters, which are required only in those specific fields and in specific cases.

Figure No. 1 shows the delivery of work (or energy). It is evident that, for establishing or maintaining a dynamic equilibrium within a 100% efficient system exactly, the delivered energy must be put in again. This provides a continuous maintenance of the existing potential which keeps the "availability" of Energy or Entropy constant. This system does not deliver or consume energy in an exchange with environment, it just maintains its own equilibrium. If it has strictly no exchange with any environment whatsoever, which is the definition of a perfect dynamic equilibrium, then it strictly cannot even be noticed from the environment. This means that for a perfect equilibrium it does not make any difference whether it exists ("occurs") or not. It does not represent an "occurrence", which requires a changing entropy, which is consumption of time.

This discussion indicates that Energy and Entropy cannot be separated from each other and that the old Law of Conservation of Energy is correct only for a state of perfect equilibrium (perpetual motion). And since, as discussed above, there are fundamentally no equilibrii, the Displacement of Energy term \((\Delta E)\), which represents the compensation for the change of Entropy of any non-equilibrium, must be included in any Energy Law as an inseparable part of it. We, therefore, suggest the following change of the old Law of Conservation of Energy:

\[ \Sigma E = E_p + E_k + \Delta E \]

The new Law of Conservation of Energy as given above is valid for any "occurrence" and any system. The old Law \((\Sigma = E_p + E_k)\) does not represent a true physical "occurrence".

*Should the reader be interested in a mathematical derivation, he can request it through SPACE Journal.
Here are some of the favorable circumstances which seem to justify our efforts to obtain universal acceptance of the new Energy Law:

(a) Since we human beings constitutionally belong to the macrocosmos, it is simpler for us to see or to find macrocosmical relationships, without eventually losing the possibility of "logical" control within complex pure mathematical procedures.

(b) We are just taking off into the "Space Age," where the macrocosmos is being investigated with the combined efforts of almost all fields of physical science, including the microcosmical fields.

(c) For the first time in the history of science, the various fields of natural sciences, which still are pretty strange to each other, seriously attempt to cooperate in the exploration of space. Actually, not the various fields of science, but rather the scientists of different fields with different terminologies have worked and lived, unintentionally, toward a separating specialization.

(d) Since the models in atom and nuclear physics are mainly a simulation or copy of astrodynamical systems, using the same field distribution, the same energy and impulse definitions and the same units of mass in orbits, etc., it seems to be the most logical thought to derive microcosmical relationships as far as it is sensible, first within our own world (the macrocosmos). Today we are able to create functional macrocosmical atom models by establishing artificial satellites and by accelerating these satellites up to escape velocities and beyond. This enables us to derive and to measure all the involved parameters, relationships and results during the simulation of a procedure reproducing universal occurrences.

In today's physics any Energy or Impulse term, if applied to the motion or redistribution of mass, (for example):

\[ E_p = mgh \text{ or } E_d = m - \frac{v^2}{2} \]

or even Einstein's Energy-Mass equivalent, \( E = mc^2 \), and now Displacement Energy, \( \Delta E \), is the energy for moving, redistributing or displacing pure Energy. In fact, any automotive vehicle is using part of its energy to transport and redistribute its own internal energy (fuel, etc.) along its travel path. The most typical vehicle for this is the "rocket," which is continuously accelerating and displacing its remaining internal propellant energy to higher altitude (potential energy) or to higher velocity (kinetic energy), thus adding every impulse to the already reached velocity, or kinetic energy level. And the Basic Rocket Equation* is the fundamental and natural relationship for any automotive (self-propelled) transfer of mass into Impulse or Kinetic Energy. Since any occurrence in the macrocosmos, as well as in the microcosmos, is a continuous redistribution of mass and energy, mainly of energy, the procedure (see Figure 2) of placing a unit mass into orbit by means of a rocket becomes the fundamental model and simulation of the universal occurrence.

There are, however, no pure rockets in nature, but by employing the rocket principle for the simulation, the various energy parameters involved can be separated and determined very clearly. Since the gravity field and the field within the atom are assumed to have the same square-distance distribution, the energy contributions from the particle propulsion (or from hits or interactions by other particles) and the energy contribution from the field can be clearly separated. What actually makes this macrocosmical model so convenient for simulating and clarifying the occurrences is that here all energies or impulses are given in terms of mass (propellants) with their accurately determined "inertia." This "Inertia of Energy," as mentioned above, could not be demonstrated and was therefore not considered in any nuclear Energy and Impulse Balance before. Since this, however, is absolutely necessary for a perfect balance, and since in fact the Displacement Energy, by considering this, leads to a perfect Energy and Impulse Balance, Displacement Energy (\( \Delta E \)) the logical term in the Law of Conservation of Energy which unifies the macro and the microcosmical occurrences.

Thinking this over, it becomes clear why the

*The Basic Rocket Equation is written as \( M = \frac{V}{e} \) where the vehicle's Mass Ratio \( (M) \) is the ratio of the takeoff mass \( m_0 \) and the burnout mass \( m_u \); \( e \) is the exhaust velocity of the vehicle; \( V \) is the vehicle velocity relative to the takeoff point; and \( e \) is a natural growth number having a value of 2.718.
research in Nuclear Physics cannot find any satisfying Energy and Impulse balance just by looking for more nuclear particles, hoping that one particle will be discovered which will exactly balance the energy input and output. The experimental and analytical research, however, led already to an accurate definition of this “missing particle”. Physics here left the ground of realism in turning from rational intelligence into a meta-physical belief in a “ghost particle, neutrino” with the following properties:

<table>
<thead>
<tr>
<th>Particle</th>
<th>Mass</th>
<th>Charge</th>
<th>Energy</th>
<th>Lifetime</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutrino</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Variable</td>
</tr>
<tr>
<td>Anti-neutrino</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Stable</td>
</tr>
</tbody>
</table>

Remarkable is this hope, namely that experiments might find a “particle!”, which does not exist, but which indicates its “existence" twice, namely when it appears and when it disappears, which has no mass and no charge, but which has “energy” and a stable lifetime.

Seriously, should we continue to carry on research in this direction? The whole physics of today, including this metaphysical dilemma, is based on the old version of the Law of Conservation of Energy, which led to satisfying results only until Nuclear Physics attempted to unify the physical sciences. Now it seems that we cannot go much further in our loyal attempts to satisfy the old energy law without leaving what, up to date, is called “physics”. Instead, we should try to reasonably change or modify the old regulations, at least in accordance with other regulations, which have already been established. Here again, we should recall that these other regulations, which already exist, are “Entropy” and Maxwell’s “Displacement Current” and now “Displacement Energy”.

Furthermore, the new “Displacement Energy” derived in Astrodynamics presents, in fact, all the qualities described above for the required neutrino—including the metaphysical ones! The only difference is that the “Displacement Energy” (\(\Delta E\)) cannot be found as a “particle” of the atom, and being an irreversible consumption, it cannot be produced either, in accordance with Eddington. Instead, however, it provides a perfect energy and impulse balance, when incorporated as a new term in the old Law of Conservation of Energy, which, in accordance with Einstein, would be the link to answer the unknowns by formulating the knowns into their correct relationships.

![Figure 4: Energy Distribution of Our Solar System](image-url)
THE HISTORY OF TIME: This informative booklet written by Dr. Lloyd Motz, Professor of Physics and Astronomy at Columbia University was inspired by Girard Perrigoux's Gyromatic 39—the latest contribution to continuous motion in wrist watches. Send for your free booklet that includes many interesting facts about time. 16-pages.

The following sources of free and inexpensive materials are made available to the readers of SPACE Journal as a convenient service in obtaining worthwhile information concerning the astra-sciences and other related topics. Students, teachers and parents will find many of the listed items of extreme interest and value. Send requests to the addresses listed below. Each company or institution represented in the column reserves the right to withdraw its offer whenever it sees fit.

Civic organizations, government agencies and industrial firms are encouraged to submit material for consideration for use in this column. Send material to Arnold E. Hogen, "INFORMATION FREE," P. O. Box 703, Compton, California.

Jean R. Graef, Inc., Dept IF, 610 Fifth Avenue, New York 20, N. Y.

THE MIRROR OF MT. PALOMAR: A new door to the secrets of the universe has opened. A door through which astronomers will be able to see 6,000,000,000,000,000,000,000,000 miles into space—twice as far as ever before. It is the giant telescope atop Mt. Palomar, so powerful that the canals of Mars, if there are any.
HOW LONG IS A ROD? This booklet relates the origins of our standards of linear measurement from the days of Egypt to the Space Age. HOW LONG IS A ROD? Color filmstrip for library use only. Illustrates the evolution of standards of linear measurement.

MEASUREMENT HISTORY: Posters, 16" x 21". Companion pieces to "How Long is A Rod," these posters illustrate the inch, foot, fathom, cubit, yard, electronic gages, and the interferometer, a modern scientific measuring device.

MAP OF AFRICA AND THE UNITED STATES: Send for your copy of this large and colorful map of Africa and the United States. Excellent material for educational and reference use.

Ford Motor Company, Dept. IF, The American Road, Dearborn, Michigan.

RESOURCE MATERIALS FOR COMMUNITY ADULT DISCUSSION GROUPS: A 12-page catalog that gives a complete list of available resource materials from this organization. Many free and inexpensive teaching aids included in this catalog.

Education Department (IF), National Association of Manufacturers, 2 East 48th Street, New York 17, N. Y.

FREE PRICE LISTS OF GOVERNMENT PUBLICATIONS:
(2) 53. Maps, Engineering, Surveying.
(3) 64. Scientific Tests, Standards.
(4) 79. Aviation.
(5) 81. Posters and Charts.
(6) 84. Atomic Energy and Civil Defense.


LEARN BY MAIL: This 46-page publication gives details about correspondence study. Indiana University offers correspondence courses as a means of study for those who cannot be in the classroom. Send for this catalog for detailed information.

Indiana University, Dept. IF, Division of Adult Education and Public Services, Bloomington, Indiana.

MOTION PICTURES FROM FORD MOTOR COMPANY. The films described in this brochure have been produced for use by schools, churches, civic clubs, youth groups and general audiences. The locations of Ford Film Libraries are given.

Farrell Lines, Dept. IF, 26 Beaver Street, New York 4, N. Y.

FREE FILMS: The following films are available on a loan basis to civic and nonprofit organizations. They are 16mm, black and white sound films. The only charge involved is the return postage.

(1) Guided Missile
(2) Toward the Unexplored (Space Travel)
(3) Mach-Busters (breaking the sound barrier)
(4) Enter With Caution; The Atomic Age (60 min.)
(5) Hiroshima
(6) Ceiling Unlimited (60 min.) Outer Space
(7) The Crowded Air (air traffic problems)

The Prudential Insurance Company of America, Education Department (IF), Box 36, Newark 1, New Jersey.

THE TWENTIETH CENTURY . . . .

FREE FILMS: The following films are available on a loan basis to civic and nonprofit organizations. They are 16mm, black and white sound films. The only charge involved is the return postage.

(1) Guided Missile
(2) Toward the Unexplored (Space Travel)
(3) Mach-Busters (breaking the sound barrier)
(4) Enter With Caution; The Atomic Age (60 min.)
(5) Hiroshima
(6) Ceiling Unlimited (60 min.) Outer Space
(7) The Crowded Air (air traffic problems)

The Prudential Insurance Company of America, Education Department (IF), Box 36, Newark 1, New Jersey.
MEN of SCIENCE

George Beadle spent a pleasant boyhood on a farm in Nebraska. Were it not for a crush on his lady science teacher who inspired him in him a hunger for learning, George might be digging the good earth today. Fortunately for his fellow man though, he now digs up scientific knowledge with an enthusiasm once reserved for potatoes. His success in this new "field" has earned him many honors.

A GROUP of influential people in Stockholm recently expressed their admiration by decreeing that he share with his co-worker, Dr. Edward Tatum, half of 1958's Nobel Prize for Medicine. Their branch of medicine is the fast-growing science of Genetics, which seeks to fathom the processes of physical life by studying and manipulating the basic building blocks.

The prize rewarded the imaginative daring displayed when they abandoned the "sacred cult" of fruit fly study and used a red bread mold (Mucor sporophila) that greatly increased the potential of needed research. Beadle utilized X-ray mutated molds to establish his leadership in the chemical approach to genetic problems.

In 1946, Beadle became head of Caltech's renowned Division of Biology. This past year he abandoned his native land for a foreign shore. However, the shore is friendly England, and the stay temporary—a visiting professorship at Oxford.

The Union Central Life Insurance Company, Dept. 1F, Cincinnati, Ohio.

MET THE MAN WHO CONQUERED SPACE! This interesting booklet tells about the Spacemaster Telephoto Unit. Inside this streamlined instrument is an ultra-modern, prismatic optical system that achieves the ultimate in bright, crystal-clear viewing. For vacations...natural study...amateur astronomy and general observation, the Spacemaster is an outstanding all-purpose telescope.

D. P. Bushnell & Company, Inc., Dept. 1F, Bushnell Building, 41 East Green Street, Pasadena, Calif.

42

space journal

https://louis.uah.edu/space-journal/vol2/iss1/1
Horold W. Ritchey received his Bachelor of Science degree in chemical engineering from Purdue University in 1934. In 1936 he received his Master of Science degree in physical chemistry, from Purdue University, and a Master of Science degree in chemical engineering from Cornell University. A former petroleum chemist with the Union Oil Company of California, he served five years in the U. S. Navy during World War II. During his naval service, he was officer-in-charge of the Harbor Defense School at San Pedro, California, and was an instructor at the U. S. Naval Postgraduate School, where he taught, among other subjects, the mechanics and thermodynamics of jet propulsion. From 1948 until 1949 he was an atomic reactor engineer with the General Electric Company. In 1949 he joined the Thiokol Chemical Corporation. He is now vice president of the company and lives in Huntsville, Alabama. A member of Phi Lambda Upsilon honorary society, Sigma Xi honorary society, and the American Rocket Society, he received the C. N. Hickmon award in 1954 for outstanding contributions to the field of solid propellant chemistry. Dr. Ritchey is the author of many technical papers and the popular article, "Rocket Mail to the Moon," which appeared in the spring 1958 issue of SPACE Journal.

Thrust control of any type of liquid or solid propellant motor falls into one or more of the following categories which may be broadly defined as:

1. Thrust vector control or control of the direction of the vehicle, a process which involves generating a change in direction (pitch and yaw) along either of two axes perpendicular to the main line of thrust;

2. Thrust termination, which means simply shutting off the thrust;

3. Thrust modulation, which involves adjusting the amount of thrust at the command of some operational control.

The basic principles underlying the attainment of these three different types of thrust control have, in the past, given engineers much trouble in the design of practical solid propellant motors. However, due to the restrictions of security, it will not be possible to give detailed accounts of how solutions to these problems were approached or to describe actual devices that may now be in use.

First let us look at the problem of thrust vector control. It is needed primarily to maintain general direction and flight attitude (position of the vehicle with reference to Earth's surface). Moderate control may also be needed to correct for mechanical misalignment of the motor with the vehicle or for uneven thrust during the launching phase when the vehicle does not have enough velocity to permit aerodynamic control surfaces to function properly. Thrust vector control may also be needed at very high altitudes where the density of the atmosphere is not great enough to produce the required forces. In general, these applications do not demand very large changes in direction.

Thrust vector control may also be needed when the vehicle meets unstable aerodynamic conditions during flight. When these situations occur or when very high or varying wind direction and velocities are encountered, then
thrust vector control may require relatively large side (yaw) or up-and-down (pitch) deflections and very rapid means of effecting them.

Mechanically actuated jet vanes of the solid propellant motor provide thrust vector control and roll control of the vehicle by operating within the exhaust. Such vanes, coupled with aerodynamic surfaces, provided similar controls for the German V-2 guided missile.

One of the oldest methods of obtaining thrust vector control is by the use of jet vanes, a method used on the German V-2 and by several contemporary guided missiles. The most common application of this method has four vanes positioned within the jet exhaust stream of the motor, as shown in figure 1. Often these jet vanes are mechanically linked to aerodynamic surfaces called ailerons or elevons. They have the advantage of providing roll control (prevention of the vehicle from rotating about its long axis) as well as providing for side movements when they are applied to a single nozzle. There are, however, two disadvantages to the jet vane: (1) large side movements require proportionately large vanes and cross sections, both of which cause a drag loss in the jet stream; (2) the high velocity and high temperature of the exhaust gases require vanes made of materials to withstand high temperature and stresses.

The problem of finding materials which will stand up under high temperature and stress is partially solved by the use of the jetavator as a means of thrust vector control. This device, figure 2, is the central zone of a sphere, mounted on gimbals, which dips into the exhaust jet in the direction desired, thus producing the necessary change in direction. Unlike the jet vane, the jetavator is immersed only a short time in the exhaust jet. It does, on the other hand, have a relatively high drag loss during the time that it is used. Also, it is

The flexible nozzle represents a new and more sophisticated form of thrust vector control in solid propellant motors. Like the jetavator, it can not establish roll control in single motors.

Reversal nozzles, mounted around the main nozzle, offer a means of positive end of thrust for the solid propellant motor. However, they require the addition of a plenum chamber to the total weight of a solid propellant motor. Not capable of providing roll control unless the motor is fitted with multiple nozzles.

A third device for attaining thrust vector control is the flexible nozzle shown in figure 3. It is adapted from a control common to liquid propellant engines where the combustion chamber is mounted on gimbals. For the solid propellant motor use, the nozzle is attached to the combustion chamber by a flexible coupling and mounted on gimbals. It is
easy to see that this arrangement can produce changes in direction by moving the position of the nozzle. From a standpoint of drag loss the flexible nozzle is more efficient than the two methods described above. But it does raise mechanical problems by requiring seals against the escape of hot, high pressure gases. And, like the jetavator, roll control can be obtained only from a motor with multiple nozzles.

FIGURE NO. 5
Reversal nozzles can also be mounted on the forward or head end of the solid propellant rocket motor, but they must be mounted at an angle to avoid damage to the vehicle by the hot exhaust gases.

FIGURE NO. 6
A hypothetical arrangement for varying the ratio of the burning surface of a solid propellant grain so as to provide thruster, obtaining thrust modulation. Such a device is one means of controlling the range of a solid propelled rocket.

In addition to thrust vector control, many vehicles require the positive end of thrust once they have reached a certain velocity. This is necessary to control their range. One method of achieving thrust termination is the generation of an exhaust jet in a direction opposite to the main propulsion stream. In this way, a reverse thrust is obtained that is equal to or slightly greater than the forward thrust. Such a reverse jet may be accomplished by reversal ducts connecting into a plenum chamber at the aft end of the motor, as shown in figure 4. Reverse ducts or jets can also be used at the forward end of the motor, but in most cases they must be mounted at an angle so that the heat and shock of their exhausts do not damage the vehicle or its payload. This method is shown in figure 5. In either case the ducts must be opened rapidly and at exactly the same time. Failure of all ducts to open together could easily cause unbalanced side forces which could result in the vehicle’s tumbling or yawing. One possible disadvantage of this method of thrust termination is that the plenum chamber necessary to feed the ducts would mean an increase in the weight of the motor.

Another method of terminating thrust is the quenching of the burning propellant grain. This can be done quite easily by setting up a shock expansion wave inside the combustion chamber of the motor as shown in figure 6. In this method a new nozzle throat area, $A_2$, opens when the old nozzle is blown from the combustion chamber. The new nozzle

FIGURE NO. 7
Schematic view of the burning process of a solid propellant grain within a rocket motor. The face of the propellant grain actually contains a "foam" zone, consisting of liquefied propellant ingredients and some evolved gas. Zone A is known as the dark zone which contains a "fizz" zone and a flame reaction zone. Zone B is the flame zone which is luminous.

FIGURE NO. 8
Graph showing the duration of thrust transients which might be induced as a result of thrust termination in a solid propellant rocket motor.
throat area has an area larger than the old one, $A_1$. This sudden increase in throat area sets up a shock wave inside the combustion chamber and puts out the burning propellant grain. A simplified and schematic view of how this is done is shown in figure 7, which represents a burning propellant grain consisting of an oxidizer and a fuel. The products of the burning, at combustion chamber temperature, occupy region B. Between region B and the surface of the propellant grain, there is region A where the oxygen-rich and the fuel-rich gases formed by the burning propellant grain mix and react. During normal combustion, heat is transferred from region B to the surface of the propellant grain, through region A, at exactly the right rate to support the burning process as the surface of the grain is used up and recedes. When the nozzle, shown in figure 6, blows off, an expansion wave travels through the combustion chamber. The reacting gases in region A expand and cool the surface of the propellant grain to a point below combustion temperature. Naturally the grain ceases to burn. Under atmospheric conditions it is normal for the grain to reignite after several seconds. But at high altitudes, region A is so diffuse and the reaction is so slow that combustion energy is not generated close enough to the surface of the propellant grain to reignite it.

There are two important advantages to thrust termination: the weight of the motor need not be increased, and the possibility of tumbling is minimized because of the exhaust flow of the gases is still along the main thrust axis of the vehicle. However, there is one disadvantage to this method: it introduces a thrust transient, or momentary instability, that could be troublesome for a payload in the vehicle. Suppose, as shown in figure 8, that the motor has an initial thrust of $F_1$ and that the time interval $T_1$ is necessary for the mechanical system to blow off the nozzle. At
The U.S. Air Force's Thor Able vehicle is a three-stage missile used for Nose Cone tests and Space experiments. The missile's third stage has a solid propellant rocket motor while the first and second stages are liquid propelled. (U.S. AIR FORCE Photo)

At the end of $T_1$ the thrust climbs rapidly to the value $F_2$. Since the expansion wave travels at the speed of sound (approximately 3000 feet per second) through the combustion chamber, the duration of the transient $T_2$ can be estimated by dividing the length of the motor by 3000 feet per second. The pressure on the head of the motor causes a more or less level peak in thrust for this period. After this, the thrust decays rapidly to zero during the interval $T_3$. In connection with this transient force, it is also possible that other transient forces could be caused by the relaxation of tensile stresses in the combustion chamber.

Since thrust is approximately proportional to the operating pressure of the motor, a method for varying this pressure appears to be the best approach to controlling the amount of thrust or—in other words—to obtain thrust modulation. Since chamber pressure is affected by the ratio of the burning surface of the propellant grain to the nozzle throat area, any such method must be based upon varying the ratio between the burning surface of the propellant grain and the nozzle throat area. This relationship is shown graphically in figure 9.

Perhaps a little painless mathematics will help clarify the meaning of this graph. It is obvious that as the curve grows steeper the changes in $P$ (pressure) become proportionately larger as the changes in $K_n$ become smaller. $K_n$ represents the ratio of the area of the burning propellant surface to the area of the nozzle throat. The exponential $n$ here is

The U.S. Army's Nike Hercules antiaircraft guided missile has a solid propellant sustainer motor and a solid propellant booster motor. (U.S. Army Photo)
derived from the burning rate equation 
\( r = a P^n \), which states that the burning rate for a specific solid propellant is a function of the chamber pressure. In reality, the values of \( n \) range between 0.2 and 0.85. Thus it can be seen that if \( n \) has a value of 0.8, then the exponent of \( K_n \) in our first equation becomes 5. It then follows that even a small change in throat area (or \( K_n \)) will produce substantial changes in pressure and the amount of hot gas produced. All of this indicates that thrust modulation by means of auxiliary jet nozzles, as shown in figure 10, becomes easier when the value of \( n \) in the burning rate equation is high and, therefore, when the exponent of \( K_n \) is high, resulting in a very steep curve for the \( K_n \)-pressure relationship. Naturally, it is to our advantage that we have a large number of solid propellants with a wide range of burning rate exponents.

Mathematics and graphs aside, it is very impractical to vary the propellant burning surface. So, then, the nozzle throat area must be varied. But this does not mean that one nozzle with a variable throat is the answer. Indeed, this arrangement would involve many difficult mechanical and design problems. The nozzle throat area can, however, consist of the sum of the areas of several nozzle throats, the total of which can be varied. By using solid propellants having high pressure exponents, it is possible to get a wide range of control with very small variations in the total nozzle throat area. And, too, such an arrangement makes for a simple mechanical device. The scheme shown in figure 10 illustrates one possibility. Four auxiliary nozzles are arranged around a central nozzle. Each auxiliary nozzle has a conical insert which can be moved in and out of its throat by an actuator device. It is easy to see how the total nozzle throat area of the motor is thus varied. With a propellant having a high value for the exponent of \( K_n \), the size of the auxiliary nozzle throat areas needed decreases in relation to the area of the central or main nozzle. Thus penalties for drag or other inefficiencies of the expansion of exhaust gas in the auxiliary nozzles would have a very small overall effect on the efficiency of the vehicle.

In conclusion, it should be obvious that it is possible to combine two or more of these thrust control devices in order to provide all three types of control on a single rocket motor. All are relatively simple mechanical components. And their simplicity increases their reliability. They demonstrate that the solid propellant motor has at last proven its worth in a field once dominated by the liquid propellant motor. In short, the solid propellant motor has outgrown the names jato and booster.
Name
Street
City Zone State
Title or position
Company

Also enter the following additional subscription at the Gift Rate of only $1.60 for 1 yr. (in U. S.):
Name
Street
City Zone State
Title or position
Company

☐ New subscription ☐ Renewal ☐ Payment enclosed
☐ Send bill for [1] [2] subscriptions

Signature

Subscription & Gift Order Form

1 yr. $3.00

☐ All other countries

Published by LOUIS, 1959
The need to know—

Within a short time, our missiles and satellites programs involved hundreds of thousands of people—ranging from Senate Finance Committee members to the girls who type invoices for materiel suppliers. Sputnik I brought an interested and enthusiastic public.

Some textbooks were available for the engineers. There was almost no literature for the layman, other than science fiction.

Out of this need to know came SPACE Journal, conceived by the Redstone Arsenal scientists who launched the Explorer satellites.

SPACE Journal is a progress report of a new, furiously expanding field. It interprets for the layman the theories and philosophy of space, interplanetary flight, astrophysics, and the actual accomplishments. Begun as an amateur effort, SPACE Journal's first issue was 5,000 copies. An additional 15,000 copies were printed to satisfy the demand, and sold at the newsstands of twelve cities. A company was formed to continue its publication as a quarterly.

The print order on the second edition was 100,000. There was an instant demand for copies from government agencies, the armed forces, the press, educators and industry. To fill an order for Stars & Stripes in Europe, 2,500 copies had to be taken off the newsstands.

The print order of the third issue was 120,000. SPACE Journal is distributed nationally by the Independent News Company.

The importance of space flight is emphasized by the current appropriations of $510 millions for space flight research. SPACE Journal is read by the people who sign the orders; the designers, engineers, manufacturers; the technicians and workers who operate them, and a large portion of the educational world. It offers a tremendous new and unduplicated potential for your advertising effort.

And SPACE Journal’s general readers are an enormous plus value, an audience appreciative of your efforts, a potent nucleus of informed opinion; and include the young people who will be responsible for the future of space flight.

SPACE Journal advertisers include:
Brown Engineering Company, Inc. ... Chrysler Corporation ... General Astronautics Corporation ... Glen L. Martin Company ... North American Aviation, Inc., Rocketdyne Division ... Precision Engineering, Inc. ... Reaction Motors, Inc. ... Reynolds Metals Company ... Robbins Aviation ... Sperry Rand Corporation, Ford Instrument Company Division ... Thiokol Chemical Corporation, Redstone Division.

SPACE Journal

published by Space Enterprises, Inc., 316 Howerton, Nashville, Tenn.

ADVERTISING REPRESENTATIVES:
Ren Averill Company, 232 North Lake Ave., Pasadena 1, Calif. Telephone MUrray 1-9291
Murray Bernhard Associates, 118 E. 40th St., New York 16, New York. Telephone OXford 7-5420

Published by LOUIS, 1959
serving industry and the national defense

In modern plants strategically situated throughout the country, Thiokol is making many significant contributions to the art and science of rocketry. By developing new and better propellants (both solid and liquid)—by designing and building improved power plants to utilize these fuels—by furnishing essential support equipment... Thiokol helps to strengthen the nation’s defenses, helps push back our spatial frontiers.

Engineers, Scientists: perhaps there’s a place for you in Thiokol’s expanding organization. Our new projects present challenging problems and a chance for greater responsibility.