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Space Focus

Space Enterprises, Inc.

space focus

Move of ABMA from Army to NASA—

President Eisenhower. "The contemplated transfer provides new opportunity for them (ABMA to contribute their special capabilities directly to the expanding civilian space program."

Werner Von Braun, Technical Director, Army Ballistics Missile Agency, "the President has decided that it is in the best interest of the country that our work be continued within the framework of the National Aeronautics and Space Administration. Since NASA's establishment a year ago, we have worked harmoniously with that fine organization.

We look forward to a continuation of our efforts with NASA in a progressive space program which will make this nation second to none."

Major General John B. Medaris," I am both pleased and relieved by the President's decision. It will stabilize the situation and the mission of the great development organization I have had the honor to command since its activation Feb. 1, 1956."

On Polaris Missile—

Admiral James Russell, Vice chief of Naval Operations," despite all the miliary value one finds in the *POLARIS* submarine system, I would not advocate having it as the only retaliatory system. A single system can be met with a single countermeasure, and although the countermeasure against the *POLARIS* is not now evident, in consideration of it we should have some variety in our retaliatory locker."

On sustaining man in space—DR. RUSSELL O. BOWMAN, CHANCE VOUGHT space medicine man, is conducting experiments to find out how man can breathe and eat while on space trips. Answer: Algae probably. Two white mice lived in sealed jar—algae provided the mice with oxygen, mice sustained plant with carbon dioxide. Food pellets was thriving diet for the mice.

On motivation for public support of space programs—"Scientific curiosity, the basic human urge to investigate the unknown, the lure of outer space as a limitless scene for high adventure . . . offer only flimsy basis for the sort of large-scale collective enterprise that a space exploration must be," asserts DR. SIMON RAMO. "The promoter of a particular space project . . . had better be prepared to argue pretty cogently that his project will yield the public either some impressive military advantage or else some economic return that outweighs the cost. Group survival, or else comfort and convenience, are the substantial group motivations he must enlist in support of his personal enthusiasms . . . The program must appear to do so, and the facts must on the average fit that appearance."

On timetable for man on the moon—Present technology with adequate support can put man on the moon between 1980 and 1985, according to the timetable of Y. C. LEE, AEROJET-GENERAL spaceman. First step will be made this year as the X-15 goes out 100 miles for reasonable length of time to explore environmental effects. Then, man can go into orbit (220-300 miles out) for a couple of times via Project Mercury in about two years to determine reactions on sustained flight. Then: 1965-70, man in orbit for indefinite time with capability of return; 1970, instrumented orbit into real space, 20,000 miles or more to study influence of moon's gravity. 1980—orbit man around the moon for first hand observation and provide return capability or space platform. Then, man will be ready to make his first landing.

On life on other planets—Discovery of life on other planets would be one of the most momentous events of human history and next to synthesis of living matter in a laboratory, the most important step that

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could be made toward an understanding of the problem of the origin of life, according to DR. ALBERT ROACH HIBBS of CALTECH'S JET PROPULSION LAB. "Telescopic observations show large scale chemical processes involving carbon are taking place on terrestrial planets," he revealed . . . Other possible origins of life on other planets: Panspermia—the scattering of life-bearing seeds through space so that they fall on planets and germinate where conditions are favorable. Spontaneous Generation—at the molecular level. Unmanned vehicles to Mars can radio back information on the chemical constituents of life there.

Marquardt—(cont. from p. 9)

and feasibility studies on Air Force Project Pluto, in conjunction with the Lawrence Radiation Laboratory of the University of California.

Marquardt is sure that further studies will show that a nuclear ramjet can carry a larger payload through the atmosphere at less weight and cost and without the shielding problems inherent in other systems.

While Marquardt holds a virtual monopoly on ramjet development and production, his company's interests extend deeper into more advanced, sophisticated propulsion systems.

"Yes, we're working on electrical propulsion research," Marquardt declared. "Our ASTRO—Air-Space Travel Research division—actually is studying many propulsion systems for space vehicles and carrying out research projects dealing with aerothermodynamics, magnetohydrodynamics, combustion, fuels and propellant combinations."

In discussing electrical propulsion, Marquardt pointed out that the principal actually isn't new.

"The cathode ray tube in a television set is an ion accelerating device," he explained.

The big problem in space propulsion: "We have to figure out how to generate the electrical outlet in a system to get the power to accelerate the choice particles. You need an electro magnetic field to harness the ions."

But it's not insurmountable. Marquardt predicts electrical auxiliary power will be ready in a few years.

"The military application will come the soonest," he stated. "In a few years, we will be able to provide electrical propulsion for course correction and orientation of reconnaissance satellites. The military is going to have to pinpoint the satellites in the right direction."

Primary electrical propulsion will come much later he feels.

Primary propulsion for true space flight will come after we develop space platforms.

Theorizes Marquardt: "Electrically powered space ships probably will have to take off from space platforms. We must launch them —the space ships—from space."

"A very small amount of thrust is very efficient in outer space," he noted. "Electrical propulsion will provide an infinitesimal thrust for infinite times from such platforms."

Roy Marquardt, now just in his early forties, is an acknowledged leader in the development of non-conventional propulsion. He founded the Marquardt Corporation at the ripe young age of 26 to put his ramjet propulsion concepts to work.

His interest in ramjets was sparked in 1942 when, as engineer in charge of naval research at Northrop Aircraft, Inc., he was assigned a research program to delve into methods of cooling engines mounted within the wings of an airplane.

Two years later he accepted an appointment as director of aeronautical research at the University of Southern California to pursue the ramjet development concepts which the Navy was sponsoring in a program for a subsonic ramjet at USC.

Marquardt organized his own company to provide the development and manufacturing requirements for that program.

In his 20 years in aerospace pursuits—half his life—Roy Marquardt is credited with multiple achievements in the field of supersonic propulsion which led to the development of the supersonic ramjet as a production powerplant for the Air Force air defense Bomarc interceptor missiles.

He took both his Bachelor and Master of Science degrees in aeronautical engineering at famed California Institute of Technology. During his graduate work, he held a teaching fellowship, giving him a rounded academic, engineering, business background rare in one individual.

Roy Marquardt's interest in air and space technology began, however, long before he entered Cal Tech.

Nearest he can remember he was about nine when he took his first flyer in the world above—in a small scale. Inspired—as were many youngsters—by the era of the heroic, historic flight of Lindbergh in the first trans-Atlantic solo—young Roy turned to building model airplanes—avidly.

So great was his enthusiasm that he soon flamed the spark for the hobby in many of his school friends. And in so doing he created his first business venture.

His hometown of Burlington, Iowa, was just too small to provide the supplies for so sophisticated a hobby as model airplane building. Roy and his friends were faced with a 100-mile journey to get their supplies.

With the ingenuity that was to spark his career, Roy set up a model parts depot at the YMCA, stocking kits in a locker and selling them over the counter. He expanded by organizing classes in model airplane building—thus creating an even greater market by initiating more novices.

Thus, out of his appreciable profits, he supported his own hobby.

In the step by step chronology of moving ahead in successive steps, Roy turned to gliding by forming a club and building a glider with his friends. A Model A Ford towed the glider to the then fantastic speed of 50 mph. And Roy logged 40 flights.

"This early business background has been a great help," he noted. "I was keeping books by the time I was 12 to show what people owed me, and I developed a healthy respect for the business side of any venture."

However, his model airplane trophies which he keeps in his collection are obviously still his greatest point of pride.

Thus, in his earliest years—Roy Marquardt's destiny was forming. Today he is aiming his company's efforts higher and higher, just as he did his own in boyhood.

With his eyes focused on space, he is building his company to take part in the great adventure possible. In addition to strengthening his firm's capabilities to meet space technology demands head on, he expanded it still further last year by acquiring the Cooper Development Corporation as a wholly owned subsidiary.

Cooper provides the knowhow in solid rocket development to complement Marquardt's own capabilities.

The subsidiary played a prominent role in the International Geophysical Year by providing rockets and components for high altitude weather and atmospheric soundings, studies of solar phenomena, particulate samplings and final stages of propelling satellites into orbit.

The subsidiary is now into the second phase of Project Sun Flare. It is boosting 50-lb. payloads in 1760 pound Nike Asp rockets to further study of solar phenomena under the direction of the Naval Research Laboratory. The ASP vehicles are Cooper developed.

Today, the Marquardt Corporation stands out as a leader in the exciting field of space technology. The credit goes to its founder.

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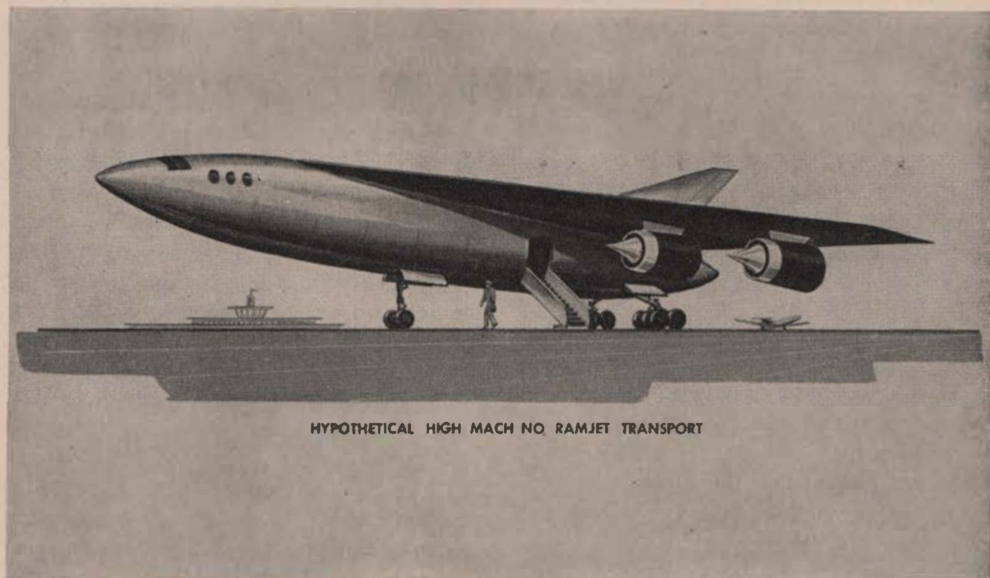

Roy Marquardt has come a long way from the air-struck youngster who built powered airplane models. But every step he has taken since he was nine years old has led him to his present eminence and prepared him for the many contributions he is yet to make.

Joining his collection of childhood honors are the citations to a engineer-businessman. He was named the "Outstanding Engineer of 1958" by the San Fernando Valley Chapter of the California Society of Professional Engineers and this summer was saluted by the Los Angeles Chamber of Commerce on the 15th anniversary of his company. He is a Fellow and former vice president of the Institute of the Aeronautical Sciences, a Fellow of the American Rocket Society. He also is a member of the Society of Automotive Engineers, American Ordnance Society, American Society of Mechanical Engineers, American Helicopter Society and the Young President's Organization.

Brainy, friendly and articulate, Roy Marquardt's eyes are on the future as he guides his company into the space age. And he sounds like a man who knows where from he speaks as he affirmatively concluded:

"The ramjet is not through by a long way. It's full potential is yet to be realized."

♦ ♦ ♦

weightless man

future, Space platforms circling and surveilling the surface of Earth, and even Lunar bases. And there *will be* the weightless man floating through interplanetary Space.

Let us imagine, now, that you are a passenger on one of these Space ships. Without getting too deeply involved in physics, you may ask what happens when you find yourself, say, practically outside of the gravitational field of Earth. You are weightless, but does this mean that you are also free of any pull of gravitation? Of course not, because the gravitational force of the Sun and other stars is still acting on your body, accelerating you along an orbit akin to that of a celestial body. This condition may be thought of as a free fall through Space, with no other forces felt than those within your own organism, moving in a curving path that eventually ends in the center of the mass or masses that attract you. There is no difference between the biological effects of weightlessness encountered in this mode of travel and the one experienced in a parabolic flight within Earth's atmosphere.

Let us continue to imagine you are in a Space ship going to the Moon. First of all, the various propelling, cooling, and cycling systems must be so constructed that they con function properly in zero-gravity. That is, no free-foll or weight factors will adversely effect any portion of the equipment. We have had some unfortunate experiences in our zero-gravity flights: after a few seconds of weightlessness, both fuel and oil pressure went back to zero. Mechanical pressurization of the fuel tank and a closed lubrication system will be necessary to remedy this disconcerting situation. Furthermore, the Space ship designer must know how various materials behave under gravity-free conditions: gases do not rise; for instance, there is no exchange due to differences in specific gravity, but dust and all unsecured solid objects may float and settle everywhere; and liquids tend to assume spherical shapes. These factors have serious effects upon many a conventional instrument and apparatus design.

Naturally, all things in the Space ship must be held in place, and this goes for the traveller, too. Without a restraining harness you will float out of your seat upon a healthy sneeze. Since you already lost your feel of being supported, the harness should be of the full-bodied type, even covering your lap and pressing you gently in your seat by means of elastic strings. If you should inflate your pressure suit while you are not secured in your chair, it will give you a false feeling of support and propel you upward so that you bump against the overhead. This then leaves no doubt—even if you are floating freely in the cabin—about which is up and which is down. There hardly exists the need for a special means for orientation other than adequate lighting inside of the ship.

Since visual reference is the most valuable means of orientation in zero-gravity, the eye functions must be maintained under all circumstances, particularly during the weightless condition. However, as long as the eye functions properly, the loss of the gravitational direction is not alarming, for the interior of the Space ship should be so constructed that the seats, head rests, table tops, floor and ceiling of the cabin, etc., will always indicate the directions up and down, as do the respective parts of our body. This directional arrangement, though valid only relative to the vehicle, will still be convenient and practical, for it sustains that frame of reference to which man on Earth is accustomed. For this reason everything within the ship will be as familiar, simple, and functional as possible. There will be beds, washrooms, recreation facilities, and provisions for nutrition and elimination. From this vehicle, an improved version of the modern airliner or submarine, you will have a new look at the old world: you will see Earth as one of the stars.

This weightless flight to the Moon is not just another creation of fiction and fantasy. It is based on our own experience during the many parabolic flights which, a few years ago, were thought to be impossible and as fanciful as flight into outer Space. But we flew, worked, ate, drank, and tried the means for human comfort in the gravity-free state ourselves; and we now translate our experience into common terms, and project it into a realistic future.

As a result of our experiments we know that care must be taken for the well-being and safety of the passenger. The seats probably will be of the reclining type, adjustable in position and angle, and easily converted into a bed. Hammocks are impractical in a Space ship, because they would tend to float at every move you make, and they may start swinging rythmically with the beat of your snoring. The sleeping bag with a zipper on top, attached to your chair, will hold you down very softly at night, and may prevent wild dreams and feelings of terror, which could be otherwise brought about by the unconscious sensation of lost support. As a matter of fact, your sleep may even be sounder in the weightless state than under normal conditions, since your posture of rest is naturally associated with a shift in weight distribution in your body and its main points of support.

If you wish for breakfast in the morning, the Space stewardess will simply push the tray over to you. It then drifts through the air as though passed by a ghost servant. It is made of plexiglass and shaped like a box in order to hold its contents together. Inside there are compartments with cereal, slices of bread, spray cans with coffee, juice and cream, tubes with butter, honey, fruit jam, and fresh fruit at your disposal. Of course, all liquids are kept and served in squeeze bottles, because one cannot drink from an open container in the weightless environment. Experiments on eating and drinking during parabolic flights have shown that the liquid floats out of the glass and hits the face with a splash just by lifting the container; thus it is possible to drown in your own cup of coffee because the liquid disperses upon contact like at an explosion and slips into your respiratory tract with the whiff of a breath.

You won't have to adjust your seat from the sleeping to the sitting position, for the tray is not going to fall off your lap. Thus, you will bring up your knees to anchor your breakfast tray, open the lid on your side, and start preparing the food. You reach inside, squeeze the contents of your butter tube on the freshly toasted bread so that it sticks, distribute it without any difficulty, for you have already learned to control your movements, and spray a layer of honey on top, taking care not to let it float too high up, because it may be glued against the cover of the buffet box. Then you take the coffee bottle from its holder, open it carefully so that nothing floats out, put some lumps of sugar in, squeeze in some cream, shake and mix the ingredients and then press the button while holding the container between your lips. You can chew and swallow without much effort, because both activities are not affected by the lack of weight. The elastic forces of the peristalsis take care of the rest and transports the food through the body. It's better to have your eggs boiled rather than fried or scrambled, because the latter procedures may prove somewhat difficult. We still are working on a frying pan that would do the trick. Boiling seems to be easier. If you don't shake your electric cooker, which has some special features to be patented, you can boil things in it without trouble. Handling medium boiled eggs may be somewhat messy, you would do well to ask for the hard ones which you can chew, or the soft ones which you can suck out of the shell.

You may not have to go to the restroom so often as on Earth since the contents of your stomach, intestines, and bladder are weightless and will not trigger so easily the reflexes that give you the feeling of an urgent need. But getting off your chair demands some caution. First, you will press your suction type shoes against the floor, get out of your harness, keep your hands on the rail and move slowly, bit by bit, to the restroom door.

Once in the restroom, you are confronted with another problem. You must rely on closed and sealing containers for your relief, which withdraw and seal whatever leaves your body. Waste bags will be available for this. The lavatory facilities are already a headache on our present-day airliners; and in a Space vehicle the commodities most probably will be under par. Washing your hands can be accomplished only in a transparent water sack. You will stick them through two elastic rubber valves which seal your wrists, push the water inlet pressure button, the soap squeezer, clean your hands, and finally force the water out by a suction pump. During all these maneuvers, your feet will be solidly held to the floor by a mechanical device. You dry your hands on a towel and store it properly. As to the elimination of all waste products, it must be done because of the hygiene and comfort of fellow passengers and done with respect to mass alterations within the ship, which might be brought out of course or orbit.

Hence, not all of the trip is pleasant. Take Johnny, for instance. He is slowly turning pale and green in his corner; and his father has already signaled to the stewardess that something is wrong. About 20 percent of the passengers in our parabolic flights became sick; and females and youngsters will probably become ill with gastro-intestinal symptoms during weightlessness, if the present statistics on motion sickness hold true for Space sickness. By swaying, floating and moving about, one arouses the perceptual mechanisms that register the position, motion, and support of the body under both weight and nonweight conditions. Now, under the latter, the sense organs for maintaining equilibrium and orientation send signals which actually confuse the Space traveler to his brain. Thus, he vomits and has some trouble catching everything floating around and storing it in the "burp" bag.

Our pilots are hardly ever plagued by this type of Space sickness. They have been exposed to weightlessness and changing accelerations so many times that they are familiar with it. They have their instruments which indicate the vehicle's position and attitude relative to Earth.

Our pilot has been fired into the air; and is now supervising the instruments which guide the ship along its predetermined course. On one hand he is completely on his own; but on the other hand, he is not. He cannot leave or land his ship in case of emergency because he is beyond his point of return. He must make it or ask for help from the base to which he is steering. He will be told from there what to do. In this stage of the flight, there is no input or feedback of the controls. As a matter of fact, monitoring and firing of the gimbal-mounted steering rockets have nothing in common with the conventional type flying. He calmly checks his instruments; everything goes as programmed. He is now flying with the cockpit extended; it was telescoped inside of the hull during penetration of the atmosphere. There is no flying by the seat of the pants during weightlessness, nor any sensation of lift or drag on the ship. As a matter of fact, his control surfaces are idle. Gliding through Space is nothing but a push-button affair and an eerie kind of locomotion. For landing on the Moon he needs little more than his brake rockets. This will stabilize the ship and restore the weight. Only when he plunges back into Earth's atmosphere will his flying skill be required.

Moon is now just in front of the vehicle. You look up from your journal which hangs in the air by itself with the pages extended, slowly drifting away in the stream of circulated air, and listen to the announcement over the intercom giving the ship's latest position. The picture on the television in the passenger compartment shows the Moon's huge, bright, Sun-lit cap on the velvet-black background of the star-speckled sky. There is no sensation of motion, and you—resting in absolute weightlessness—have the feeling of being suspended in between these un-blinking stars. The radio is silent; and only the soft hum from the vents which circulates the air inside of the cabin is still audible in the silence of Space. You feel physically relaxed, but otherwise somewhat uneasy in this seemingly unreal situation. The stewardess removes her cap, and her long hair stands straight up, slowly drifting back and forth in the air stream of the recycling fans. Your hands start sweating. So you pull the sprayer from your bag, wet them with cologne, and wipe it off with the handkerchief. Then you take a cigarette and snap your lighter in vain, and—forgetting where you are—you try it again until it occurs to you that no flame will burn in zero-gravity. Therefore you ignite the cigarette with the electric lighter and puff, completely unconcerned about the possibility of dropping the ashes.

The end of our make-believe trip brings up an important point: the conditioning and training of future Space travelers. Elaborate propulsion and training devices have been suggested by experts for training the crew and passengers. They are based correctly on the assumption that man must be adapted to the zero-gravity condition and to the sensation of weightlessness. They should also be exposed to increasing and decreasing accelerations in order to adjust their feelings, coordinations, and performances to the effects of changing weight.

In this respect, it is apparent that the best training available now will be achieved by parabolic flights in high-performance aircraft. Such flights will serve a double purpose. First, people who cannot stand the weightless condition and the changing accelerations associated with rocket travel will fail; and they will have to postpone their trip to the Moon until other modes of travel are available. Second, the ones who can stand it become conditioned and used to weightlessness, as well as to the means which protect them against potentially adverse effects of prolonged periods of weightlessness. We know that a man will fall to his death if he loses his balance at the rim of the Grand Canyon;

but instead of trying to increase his tolerance to falling, we provide him with the means which help him to prevent the accident. This principle must also be applied to the weightlessness associated with Space flight. An appropriate harness, foot rest, fixtures to put himself and his utilities in, suction-type shoes, handrails, and safety ropes will prevent floating and involuntary movements of objects; and he must be trained in the skillful utilization of such devices for comfort and safety. The construction of these devices is no serious problem once we know what is going on in zero-gravity. We do a lot of things where we can fall and hurt ourselves: climbing on roofs and trees, riding and jumping on horseback, playing football and driving a car at high speed, creating enormous accelerations which often lead to fatal accidents. We must not forget that weightlessness is a physically stressless situation which in itself does not involve any bodily harm or danger. If we observe the necessary precaution and adapt ourselves to its characteristics, it will provide us with luxury and pleasure not normally attainable on our planet.

However, our Space travelers must be schooled in the readaptation to gravity from the weightless state. We do not expect too much difficulty with this either, because this should even be more easily accomplished than his adjustment to zero-gravity. We are accustomed to the gravitational force from birth, and we will snap back into it with ease and regret. To the seasoned Space man the return to Earth and its gravitational field will be a return to his original and familiar state.

space food (cont. from p. 12)

In actuality this idealized plan may resemble only remotely the system finally put to test in long and ever longer Space excursions. But recent research in several fields has indicated that the man is likely to be both the weakest and the least readily changeable element in the closed-cycle system.

Selection and preflight training will make significant contributions to the crewman's successful Space operation; but, fortune being what it is, he is still a man and as such must be maintained within rather narrow limits of pressure, temperature, humidity, pH, and nutrition even to stay alive. And for him to perform optimally, the limits must be moved still closer together.

On the other hand, the remaining components of the system are not so rigid.

The algae provide a fitting research subject mainly for taxonomists and photosynthesists, with a brief interlude of intense interest in their introduction as a field crop to be competitive at least with other animal feeds.

In this melee, there has been but little attention given to the physiology of the algae and practically none to their functional characteristics such as the production of oxygen or to their expected behavior in a small, closely coupled, closed-cycle feeding system in a weightless environment.

No one knows what would be revealed by a study of any substantial portion of the 40,000 kinds of algae which exist. There may be one in this group whose aquatic temperament is ideally suited to the slavish service required in the unremitting production of food for the Space man. The possibility also exists of finding a species better suited for use as human food than those presently known.

Even less is known of the somewhat higher plants such as the ferns, lichens, and the like which, if they could be grown rapidly enough, would probably make for a drastic reduction in the water requirements of a closed-cycle system.

It is conceivable that the interposition of animals capable of using the algae as food might serve to provide increased acceptability in the Space diet. The algae, daphnia, small fish diet sequence has been suggested as a simple possibility. Virtually nothing of a quantitative nature is known about this set of occurrences; and, with the exception of a pitifully small number of misguided college students who have swallowed whole goldfish, nothing at all is known of the acceptability of the many, small-size, completely edible fish. Also, nothing very useful is known about their waste products, which would be cycled into the system were they to be an integral part of it.

Instead of a concentration of 50 percent of algae as supposed in our ideal bio-converter, present possibilities are of the order of one to a few percent. This is in part due to the limited availability of carbon dioxide and light but is as well dependent on ready access to nutrients. It would seem that the algae would grow at unheard of rates and to very high densities if these difficulties could be overcome by the intimate mixing of the culture with carbon dioxide, light, and nutrients. So far, the success of this conjecture has not been demonstrated.

For one thing, metabolic water would accumulate in the system along with cellulose, methane, carbon monoxide, and polymerized or insoluble substances unless steps were taken to keep each one under control. Theoretically, at least, all of these substances could be kept in the system by methods similar to those found in nature, the chief differences being in the size and the timing of the operations.

Electrolytic breakdown of extra-metabolic water would produce easily usable oxygen and together with it, the dilemma of large quantities of hydrogen whose destination in the cycle is still in question.

The use of a chemical analog of photosynthesis would have real advantage only if it were self perpetuating. It might avoid all of the vagaries of mutation and might even simplify to some extent the nutrient requirements of the system. What such a change would do for the Spaceman's personal diet is difficult to guess. At present there are few if any completely synthetic foods and still fewer savory enough to compete with any success against naturally occurring foods.

The body of scientists now working directly on Space feeding and nutrition is working effectively at a rate only attained by high motivation. But this motivation suffices, and their efforts will ultimately provide at least a partially closed Space feeding system by the time it is critically needed and, eventually, an ideal one for the long voyages of man into the remoter reaches of Outer Space.

primitive fear **(cont. from p. 18)**

uncertainty of the environment into specific problems. Roughly between six and four millennia ago, human rituals began to focus on seas, mountains and the sub-surface Earth. As in earlier extensions of awareness, specific events which threatened survival probably gave the necessary stimulus.

Concern with the seas in the Near East can be ascribed to an identifiable cause. About 4000 B.C. water from the Persian Gulf appears to have welled up over the Mesopotamian valley of the Tigris and Euphrates. It left Ur under 10 feet of mud and had a similar effect over an area 400 miles long and 100 miles wide. Since both the hero of the Epic of Gilgamesh and Noah were residents of the volley, the Epic and Biblical tales of survival have been attributed to this event.

Some of the traditions of a great flood from Greece, Lithuania, India, China, Australia, Polynesia and the Americas are of a similar age. The crustal, atmospheric or other causes of these catastrophic floods are unknown today, and certainly were not understood then. Human awareness of the larger threat to life may account for the worship of a sea-god, which in some places became preeminent at that time.

During the same period, our forebears were concerned with mountains and portrayed the fiery interior below Earth's surface. In the past, as at present, many volcanoes erupted and destroyed life. Such events may explain why volcanic mountains have been objects of fear and propitiation. All mountains may have come to seem unpredictable and therefore sacred—the Himalayas, Mount Sinai and Mount Olympus among others.

Crustal disturbances have also occurred, probably more than once, at the series of chasms and depressions which have been grouped under the name of the African rift. These extend through East Africa, the Red Sea, the Gulf of Aqaba, the plain of Sodom and Gomorrah, the Dead Sea, the Sea of Galilee, the River Jordan and into Syria. Evidence of eruptions of lava and frequent earthquakes have been noted along this line. It is believed that Sodom and Gomorrah were destroyed in about 1900 B.C. in an area now under water at the southern section of the Dead Sea. The destruction resulted from a great earthquake, which was probably accompanied by issue of natural gas, explosions and conflagration. Outpourings of lava from sections of the rift, as well as from volcanoes, may account for the fear of a burning hell below.

Great as was the concern with terrestrial forces, the celestial concern soon superseded it. Around the globe, communities began to worship a god high in the heavens. Earlier deities were relegated to subsidiary positions. Today, the Aborigines in Australia and Fuegians in South America resemble more advanced civilizations in their search for ways to secure the favor of a sky-god.

By the second millennium B.C. the vast idea that our world will end had begun to spread. In vivid detail, our ancestors portrayed a fiery consummation of Earth.

Many communities expanded their fertility rituals to include the larger environment. By sympathetic magic and extreme sacrifices, they sought to promote cosmic order. Among some peoples, altar offerings to heavenly deities included men, women and children. Others identified their priest-kings with the Sun. Through earnest service to the king, they hoped to ensure a world without end.

Some personified the sacred seven bodies with movements differing visibly from the stellar background. They sacrificed to the Sun, Moon, Mars, Mercury, Jupiter, Venus and Saturn.

Others sought satisfaction in the philosophical denial of life itself, and an effort to achieve mystical union with the cosmos.

Some envisaged a future life on other worlds in the heavens.

In this period, too, birth and after-life rituals became much more intense. Maternity, nativity and the generative organs were celebrated in varied ways. Beginning shortly after 3000 B.C. preparation of megalithic tombs for the after-life became a central activity for many peoples. By these means, men may have sought to defy the greater challenges to survival which they recognized in the larger environment.

The orientation and intensity of these rites suggest that something attracted our forebears' keenest attention to the cosmic environment. Each previous focus of ritual had a practical basis—from the large to the small game, rain, rivers, fertility, male cattle, seas, mountains, Earth's molten interior, and others. While the responses of prescientific peoples were necessarily symbolic, they all constituted attempts to cope with problems of survival. Religious practices directed toward the heavens hove likewise been symbolic; but it is reasonable to suppose that they also originated in vital concerns.

The source of concern, however, is difficult to establish. Judging only from the words of our ancestors, celestial disturbances occurred sufficiently close to affect Earth. Sacred, epic and historical documents from many ancient civilizations tell of such events.

Many explanations for these accounts have been offered. Theories range from solar eclipses, comets, polar toppling, or local catastrophes to Velikovsky's popular interpretation (*World in Collision*, Doubleday, 1950). The correct explanation has yet to be agreed upon.

In the present state of science, celestial events of the past cannot be as readily identified as can geological ones. One of the few modern clues is the dwindling of comets in the Solar system. These bodies were more common in ancient times than they are now. By measuring the present rate of decline in cometary luminosity, Russian astronomer S. K. Vsekhsviatsky has developed the theory that they originated a few thousand years ago. An event within the Solar System, which started the comets, could have had effects on Earth; or it could have appeared to threaten to do so.

Whatever the causes, an orientation toward the sky did develop in ancient times. Men devised a variety of ways to cope with cosmic uncertainties. Their beliefs have helped to form the civilizations current today. Peoples on Earth still carry on a wide variety of rites directed toward the heavens. Approaches to the cosmos, expressed in some of the religions of the period of written history, are the subject of the next article.

space and the law **(cont. from p. 20)**

Below these zones, states would exercise complete sovereignty. Unfortunately, the practicability of such a system is doubtful. The difficulties encountered in resolving conflicts over the extent of territorial waters still loom too large to convince us that territorial Space would be the ideal solution.

Should the status of Space be agreed upon soon, can we then proceed to develop a comprehensive legal code to govern it? This question has to be answered with due regard to the realities of international law and its sources.

Essentially, international law consists of principles established by time-tested customs or by treaties. Law based upon custom requires, by its very nature, lengthy periods of time to evolve and crystallize. The other source of international law, the treaty, is by far the more expedient one in terms of time, depending upon the ability of states to arrive at a common formula. Space, as a new thing in international law, may call for either way of originating applicable rules. The choice of source will largely rest upon the urgency for creating a system of Space law. Should the future dictate a pragmatic legal approach to Space whereby specific problems would be dealt with individually, then we may look forward to a slow and often painful emergence of Space law. It goes without saying that legal remedies developed in this way may come at times too late to be profitable in a dispute in Space and with possible disastrous consequences to the world as a whole.

On the other hand, while law is sometimes issued in anticipation of situations that might arise, rarely have lawmakers been in favor of bringing forth laws to meet unforeseeable complications. They have preferred to tread on familiar and tested grounds rather than stand the risk of providing an inadequate and impractical system of law in a new area of human venture. Legislation based on speculative contemplation of legal problems may often have more harmful consequences than a gap in the law.

Hence, the evolution of a Space code will undoubtedly have to wait until such time as the nature of Space and man's role in it are thoroughly explored and ascertained. So long as we are unable to foresee the full legal implications involved in human activity in Space, it would indeed be premature and presumptuous to devise rules and regulations purporting to constitute a Space code. It is more likely that concurrently with scientific progress in Space, law providing us with partial solutions will come into existence. Dr. E. Pepin, director of the Institute of International Air Law, commenting on the role of lawyers in the age of Space, put the matter in its proper perspective saying: "I was and still am of the opinion that they (the lawyers) should not impair the scientific progress by discussing abstract legal principles; but they should try to establish, if necessary, new principles which may facilitate the task of scientists."

Our venture into Space will eventually call for the creation of an appropriate international agency with adequate machinery to regulate, through legislation, our activities in this new area. If ever freedom of Space is to be fully realized without resulting chaos, we will have to make a centralized effort to coordinate the development of Space law. Though it is too early to attempt the formulation of a Space code, we may nevertheless establish the framework of broader principles discussed above. We may already equip ourselves with the necessary machinery to carry out the basic research preceding a statement of Space law. When Space rules do come into existence, they will have to be periodically revised so as to conform with constant technological developments. A flexible method for making changes in Space legislation will have to be adopted. The experience gained by the International Civil Aviation Organization in regulating airspace can certainly be put into use also for Space. As in the case of this organization, an international Space convention might establish a Space agency and entrust it with the power to supplement and interpret the broad principles contained in the convention itself. The ICAO successfully employs such a technique and it has devised special codes for the use of civil aviation, entitled "Annexes" to the Chicago convention. These annexes are revised and replaced by the organization in conformity with shifting needs. The flexibility that such a system affords will prove to be especially valuable in the initial stages of Space exploration when science and experience will frequently change our concepts and practices.

These are, in brief, some of the legal problems which may arise in the coming Space age. Should we succeed in making Space the domain of mankind as a whole, we can look forward to unprecedented progress and fruitful cooperation between nations. We hope that man's folly on Earth will not be carried into the cosmos. Space is awaiting us, but surely it is not eager that we project into it our earthly skirmishes and endless conflicts.