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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
1520 H STREET, NORTHWEST · WASHINGTON 25, D. C.
TELEPHONES: DUDLEY 2-6325 · EXECUTIVE 3-3260

FOR RELEASE: 5:30 P.M.
March 24, 1961

RELEASE NO. 61-56

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TO THE NEW YORK PATENT LAW ASSOCIATION
WALDORF-ASTORIA HOTEL, NEW YORK CITY
FRIDAY, MARCH 24, 1961

THE NEW FRONTIER OF SPACE

It was less than three years ago that Congress enacted into law a truly historic piece of legislation, the National Aeronautics and Space Act of 1958. That Act created a new civilian agency of Government, the National Aeronautics and Space Administration, and gave it a responsibility radically different from anything that had gone before. In the words of the statute, NASA was directed to conduct such activities "as may be required for the exploration of space."

The exploration of space! For thousands of years man had been devising forms of government and writing laws, but never before had he presumed to deal with the limitless reaches of outer space. Now, for the first time in the long history of legislation, these words, "the exploration of space," entered the statute books, bringing with them a train of consequences which we can only dimly foresee at the present time.

From man's earliest beginnings, he has been engaged in one kind of exploration or another. The very word "exploration" calls to mind some of the noblest enterprises of mankind. We think of the great voyages of discovery of Columbus and Balboa, of Magellan and Cook, and, in our own century, of Peary, Scott, and

Amundsen. Man is an explorer by nature; there is something of it in each of us. Man demands that the unknown be reduced to knowledge; that the unfamiliar and remote, wherever possible, become the stuff of human experience.

It is not a new thing for governments to be concerned with exploration. Motivated by desires for trade, conquest, and colonization, many of the sovereigns of the past have engaged in the business of exploration and discovery, and nations have risen to greatness because of such activity. But in 1958, our nation conceived for the first time that it should be an essential and continuing function of government to undertake the exploration of the new frontier of outer space without regard to any of the motives which have moved nations in the past to reach beyond themselves into the unknown. The exploration of space is not a national program today because it holds the prospect of new worlds to conquer by the sword; nor because it offers opportunities for colonization; nor even because of the promise of economic benefits, although these may turn out to be substantial. No, the exploration of space is a national program because at this point in history man realizes, more intensely than ever before, that knowledge is power. Today, greatness as a nation depends upon mastery and control of man's physical environment; and the extension and perfection of scientific knowledge is fundamental to that mastery and control.

Man's environment is not limited to the earth; it includes the great spatial sea in which the earth itself moves. Today, man has at his disposal for the first time the tools which make it possible for him to venture forth into that great sea of space, to explore and to discover, to investigate and to learn. These tools, which future generations will doubtless think primitive, must be improved, perfected, and used in the service of enlarging the boundaries of man's knowledge. What benefits this may ultimately bring to mankind, no one today can predict, although some are already foreseeable. But one can phophesy with certainty that the exploration of space will be a great new human adventure from which it is inconceivable that man will withdraw, regardless

of the frustrations, the heartaches, and the costs that it is bound to entail.

In considering our nation's space exploration program, it is well to know first of all what it is not. It is not a program designed to create new and more powerful weapons or, for that matter, defense against such weapons. It is a program devoted to peaceful purposes.

The National Aeronautics and Space Act of 1958 contains a declaration of major historical importance. At the very beginning of the Act it states, "The Congress hereby declares that it is the policy of the United States that activities in space should be devoted to peaceful purposes for the benefit of all mankind." The Act echoed the words of a concurrent resolution which the Congress had passed just a few weeks earlier expressing the "devout wish of all peoples everywhere, in every nation, in every environment, that the exploration of outer space shall be by peaceful means and shall be dedicated to peaceful purposes."

Space for peaceful purposes! The reasons for creating a new civilian agency, totally outside the Department of Defense and answerable directly to the President, were closely tied in with these declarations of national policy. Henceforth, it was to be clearly understood that it is the policy of our nation to emphasize the civil, rather than the military, uses of outer space.

You may be assured that it continues to be the policy of the United States Government to place in the hands of a civilian agency the responsibility for carrying out this new mission of Government, the exploration of space for peaceful purposes. Among the agencies of Government, only NASA has been given this responsibility and this mission. The armed services have no comparable mission. Theirs is the supremely important mission of the defense of the nation; and in carrying it out, the military must make use of every means available to it.

This includes the utilization of space whenever that medium provides the best means for accomplishing the mission of defense. But military space projects must always compete in the total military budget with alternative means of accomplishing the same military objectives, and they will be undertaken only if they survive this competition. NASA, however, unlike the military, has been directed by statute, clearly and unequivocally, to undertake the exploration of space itself and to do whatever is necessary to accomplish it.

This mission of space exploration is one which the Congress, in effect, has decided must be performed for its own sake without having to justify it in relation to the defense needs of the nation or, for that matter, to the economic benefits which may possibly flow from it. It is a mission which stands firmly on its own two feet, justified by nothing more tangible than the total national interest in maintaining leadership in science and technology and in their application to the conduct of peaceful activities for the benefit of all mankind.

Now what does this new mission of space exploration comprehend? Fundamentally, it means using the new tools of the space age to expand man's knowledge of his environment -- by the conduct of scientific experiments in space, and by observation through the use of unmanned vehicles equipped with the most ingenious instruments man can devise. But it doesn't stop there. Ultimately, and essentially, it means the sending of man himself into space -- first in orbital flight about the earth, and eventually to the moon and the nearby planets. And finally, the exploration of space includes investigation of every possibility of utilizing space for the practical benefit of mankind, such as the improvement of weather forecasting and world-wide communications through the use of satellites.

Each of these parts of our space exploration program holds great promise, and each is progressing with a rapidity never before experienced in the early stages of a new technological development.

I shall briefly summarize what we hope to do during the coming decade in each of these areas. But first we should take a look at one of the major tools we use to do the job of exploring space -- the launch vehicles. Simply stated, a launch vehicle is a device used to propel and guide a useful object, a spacecraft such as the Echo satellite which you have all seen, from the surface of the earth into orbit about the earth or onto a flight path toward the moon or some other celestial body. The propulsive power needed for such a task has been achieved by the development of modern rocketry, beginning with the historic feat of Dr. Robert Goddard just 35 years ago in accomplishing the first flight of a liquid-fueled rocket.

Until very recently the development of large rockets was the exclusive province of the military. You are all acquainted with our long-range ballistic missiles -- the Thor, Jupiter, and Atlas. These are rocket-powered vehicles designed originally not for space exploration purposes but to launch nuclear weapons thousands of miles toward an enemy target. These vehicles, and the rockets which power them, have been carefully tailored to perform specific military tasks, and they do this job superbly. They fall far short, however, of meeting our space exploration needs. Let me explain.

The propulsive power of launch vehicles is expressed in pounds of thrust. The propulsion systems in the Thor and Jupiter IRBM's produce about 150,000 pounds of thrust, while the Atlas ICBM, the most powerful in our inventory, has about 360,000 pounds of thrust. These are the rockets which we have had to use to date and will continue to have to use for some time to come to provide propulsion for the first stages of the launch vehicles used in our space exploration program.

By contrast, the Soviet Union has had at its command a first stage which we estimate is in the 700,000- to 800,000-pound-thrust range -- perhaps twice the thrust of our Atlas.

Although this advantage in propulsive power does not imply a superiority in ballistic missile weaponry -- indeed, we are confident that our ballistic missiles can carry a warhead to the desired target with accuracy in the same manner as the Soviet rockets presumably can -- the story is different when we turn from weapons to space exploration. Their more powerful rockets with their greater weight-lifting capability, when employed in launch vehicles for space exploration purposes, have enabled them to perform some feats in space which we are not yet able to match.

Space technology, of course, is a very complex thing involving innumerable elements other than rocket propulsion. I think it is safe to say that in every other aspect of space technology the United States is at least equal with and, in some areas, clearly ahead of the Soviet Union. But this matter of the weight-lifting capability of our launch vehicles continues to be a real limiting factor in the conduct of space exploration; and the development of a new launch vehicle can't be accomplished overnight -- like the development of a new type of aircraft, it takes several years.

Government and industry are working together to remedy this deficiency as rapidly as possible. New launch vehicles are being developed that will greatly increase our capability to undertake major missions of space exploration. I should like to review them with you briefly. In comparing the expected performance of these new launch vehicles, it is necessary to use a common yardstick. The yardstick we have chosen is the number of pounds of payload each launch vehicle will be capable of placing in orbit at an altitude of 300 nautical miles above the earth.

To date, the most powerful launch vehicle used in our space exploration program is the Thor-Delta, which employs the Thor IRBM booster as its first stage. It became available for use last year and was used to place the Echo satellite in orbit. It can place a 500-pound payload in a 300-mile orbit above the earth, a considerable

advance in only two years' time over the 31 pounds of Explorer I and the 55 pounds of Vanguard I, the first two United States satellites with which we began space exploration early in 1958.

During this year, our weight-lifting capability is taking a giant stride forward with the new Atlas Agena B launch vehicle. With this vehicle, we will be able to place a 5,000-pound payload in a 300-mile orbit. This, however, will be quickly exceeded by another new vehicle which, for the first time, will add an upper stage to the Atlas fueled by liquid oxygen and liquid hydrogen. This is called Atlas-Centaur and should be undergoing intensive development testing in 1962. Centaur will be capable of placing an 8500-pound payload in a 300-mile orbit and sending 2500 pounds as far as the moon.

Neither of these launch vehicles, however, will match the present Soviet capability in the launch vehicle field. As you know, the Soviets have recently reported the launching of large orbiting spacecraft weighing approximately seven tons.

The vehicle which will enable us to exceed by a substantial margin anything the Soviet Union has demonstrated to date is the Saturn, our top priority launch vehicle. The first stage of Saturn will consist of eight engines of the type used in the Thor and Jupiter IRBM's, clustered to produce one-and-a-half million pounds of thrust, or roughly four times the thrust of the Atlas ICBM. This will be combined with upper stages utilizing liquid hydrogen-fueled engines. In its initial configuration, which we call Saturn C-1, it should be ready for its first operational mission some time in 1964. The C-1 is designed to place 19,000 pounds, almost 10 tons, in a 300-mile orbit; and it should also be capable of sending a 5,000-pound payload to the vicinity of the moon and a 2500-pound payload to Mars or Venus. A later and more powerful configuration of Saturn, called C-2, is also under development. By 1967, we expect that the Saturn program will give the United States a capability of launching spacecraft weighing over 20 tons.

Looking beyond Saturn, we have under development an engine designed to produce one-and-a-half million pounds of thrust in a single chamber, roughly the equivalent of the entire thrust of the first stage of Saturn. This tremendous engine, which will not be available for use until the latter part of this decade, may be clustered in a launch vehicle to produce a total thrust of up to 12,000,000 pounds in the take-off stage. We have used the term Nova to refer to the concept of a launch vehicle employing such a propulsion system, but the configuration of such a vehicle has not yet been determined. It will probably be the first vehicle with sufficient power to accomplish a manned landing on the moon by direct flight from the earth.

Now what does NASA intend to accomplish with this array of powerful launch vehicles during the next several years? As I mentioned earlier, the space exploration program may be regarded as having three main subdivisions. First, the conduct of scientific investigations in space by means of unmanned spacecraft to increase our basic scientific knowledge. Second, the exploration of space by man himself. And third, the development of practical applications of space technology for the economic benefit of mankind.

Up to the present time, the first of these areas, the space science program, has been responsible for the greater portion of our launchings. It has been a remarkably successful program, far overshadowing in scientific output the efforts of the Soviet Union. In a recent report to the House Committee on Science and Astronautics, NASA noted that nearly all of the highly original work that has been done in space research to date has come out of the United States program. The conclusions of the report were summed up in the statement that the Soviet Union's space science program "has dissipated some of its momentum after the initial successes of the Sputnik launchings, while the United States program has picked up momentum from a standing start and now surpasses the USSR effort in its breadth of interest, originality of concept, and volume of research."

Time does not permit an account of the scientific observations and discoveries which have been made as the result of the United States space science program during the past three years, but I should like to mention just one example in passing which represented a great achievement in space technology as well as space science. You will recall that just about a year ago Pioneer V was launched successfully in orbit about the sun between earth and Venus. Weighing only 95 pounds, it contained a variety of useful instruments designed to investigage interplanetary space and to test extreme long-range communications. The project was highly successful, transmitting data back to earth for a period of 106 days. When communication finally ceased, Pioneer V was 22 and one-half million miles from earth. This distance was 50 times farther into space than man had previously communicated and approximately five times farther than the Russians claim to have communicated with their Venus probe launched last month.

During the next few years, as more powerful launch vehicles become available to us, we plan to place in orbit a number of very complex satellites which are known by such impressive names as Orbiting Solar Observatory, Orbiting Geophysical Observatory, and Orbiting Astronomical Observatory. As their names indicate, they will have different objectives which determine their operating characteristics.

The Solar Observatory, which is scheduled for launching this year, will be stabilized in space in such a way as to point its instrumentation steadily at the sun throughout the course of its orbit. By contrast, the Geophysical Observatory, the first launching of which is scheduled for 1963, will be stabilized so that the same axis constantly points toward the earth. It will be equipped to conduct a wide variety of studies of the earth's immediate environment -- for example, the atmosphere and ionosphere in the unexplored regions above the poles.

The Orbiting Astronomical Observatory will be a very large, complex satellite weighing over 3,000 pounds. It will have a stabilizing system to lock astronomical equipment on the star, sun, or planet it is observing. With its fine pointing control, it will be able to track a star with an accuracy of one-tenth of a second of arc, roughly the equivalent of locking onto a basketball 500 miles away. Telemetry equipment will relay the satellite's observations back to earth. The first of a series of launchings is scheduled for 1963.

The scientific program does not stop with earth-orbiting satellites. It also includes exploration of the moon and the nearby planets with unmanned spacecraft. During 1962, three launchings are planned of spacecraft designed to make a rough landing on the moon. This spacecraft is being designed to carry a 300-pound capsule which will survive the shock of impacting the moon at almost 300 miles an hour. In addition to depositing highly sensitive instruments to take readings on the moon's surface, this spacecraft will be equipped with high resolution television cameras which will transmit approximately 100 pictures of the moon during the approach to landing. The last picture, taken at about 20 miles above the moon's surface, will view a 2,000-foot square and have a resolution between 10 and 20 feet.

We have called this series of hard landings on the moon Project Ranger. It will be followed by an extensive series of launchings commencing in 1963 of spacecraft designed to land gently on the moon at a speed slightly slower than a manned parachute landing on earth. This project we call Surveyor. The spacecraft for this project is now under development and will carry a variety of scientific instruments, including several TV cameras which can relay back to earth pictures of the moon's features. One of its

most interesting features is a drill which will be designed to penetrate at least 18 inches into the moon's surface. As it drills, small fragments will be brought into the spacecraft and subjected to chemical analysis. One of the TV cameras will be used to monitor this operation so that scientists on earth can watch the process on their TV screens.

By 1966 or 1967, we should be ready for the next step in unmanned lunar exploration -- the landing of a mobile laboratory, a sort of "moon jeep," on the moon. This project we call Prospector. It should be capable of exploring the moon's surface throughout a radius of perhaps 50 miles, terrain permitting, and thus obtain vastly more useful data than could be obtained with stationary craft. By mapping areas of greatest interest, Prospector should be an invaluable forerunner to manned exploration of the moon.

When the Centaur vehicle becomes available next year, it will be possible to launch spacecraft to fly close to the planets Mars and Venus to obtain scientific observations not only of those planets but of the inter-

planetary environment en route. In the second half of the 1960's, when Saturn becomes available for planetary exploration, it is planned to launch a spacecraft called Voyager to orbit Mars and Venus. It would be designed to eject a landing capsule capable of surviving entry into the planet's atmosphere and even landing on the planet itself. Thus, the orbiting mother spacecraft would observe the planet and its atmosphere from an altitude of several hundred miles, while the landing capsule would make detailed measurements during descent and on the planet's surface. Data from the capsule, including TV pictures, would probably be relayed to earth by the mother craft. The target date for this project is the 1966 to '67 period.

All of this exploration with unmanned spacecraft is an indispensable prerequisite to manned exploration of the moon and the planets.

When we turn from unmanned spacecraft to the exploration of space by man himself, an entirely new dimension of activity opens up. It is the prospect of man escaping from his earthly environment that makes the whole business the most exciting enterprise of our age. It is the thought of man being projected into a totally alien environment -- whether in orbital flight about the earth, or standing for the first time on the moon, or circumnavigating another planet -- that stimulates the human imagination as nothing else has done since the first days of powered flight a half century ago.

NASA's program of manned space exploration is pointed toward the landing of men on the moon at the end of the present decade, and eventually toward manned exploration of the nearer planets of the solar system. The goal of manned flight to the moon will determine the content and dimensions of our total space exploration effort more than any other factor during the next ten years. In fact, it is already doing so. NASA's biggest single project to date is Project Mercury, the program for sending an astronaut in orbital flight about the earth. If all goes as planned, some time late this year

the first Mercury Astronaut will be boosted into orbit from Cape Canaveral and will circumnavigate the globe three times in four-and-a-half hours before returning to join his earth-bound fellow men. In that brief journey, at an altitude of 100 miles and a speed reaching 18,000 miles per hour, he will have traveled incomparably higher and faster than man has ever done before.

Project Mercury is but the first limited, though very significant, step toward our long-range goal -- manned flight to the moon and the nearby planets. It is the simplest way to learn what we need to know at the earliest possible date about how man behaves, physically and mentally, under the conditions of space flight. Our long-range plans are based on the assumption that man can and will be an active and useful participant in space exploration; but until we take this first step, no one can know for sure.

Exploration in the vicinity of the moon will require that man be absent from the earth, living in an artificial environment, for at least a week. To explore Mars or Venus will require more than a year for the round trip. Before undertaking such missions, it is essential that man's behavior under prolonged periods of space flight be carefully investigated. What is needed for this purpose is an earth-orbiting laboratory in which men can live and operate for increasing periods of time.

Project Apollo, which will follow Project Mercury in the manned space exploration program, is designed to meet this need. It will be able to carry two or more astronauts on flights of considerable duration. However, in addition to serving as a manned orbiting laboratory, the Apollo spacecraft will also be able to take men on journeys around the moon and back to earth. In these circumlunar reconnaissance flights, which are now planned for the 1968-1970 time period, it is hoped that many of the problems to be encountered in landing men on the moon will be solved.

This brings us to the final category in our program -- the field of practical applications of space technology. At the present time the two most promising areas are weather satellites and communications satellites. The Chief of the United States Weather Bureau has said that the meteorological satellite is the most significant development in meteorology of all times -- perhaps of greater importance than the invention of the barometer itself. You will recall that NASA took the first steps on the road to a revolution in weather forecasting with the launching last April of Tiros I and last November of Tiros II. During their active life, these satellites took more than 35,000 remarkably fine photographs of the earth and its cloud cover. The value of these pictures to weather forecasting and meteorological research has exceeded all expectations. For the first time in history man has been able to perceive cloud patterns visually on a global scale. Tiros also obtained meteorological information from many sections of the world where weather information had previously been virtually nonexistent.

The Tiros series of satellites, of which two more are scheduled during the next 12 months, will be followed by a more advanced version called Nimbus, commencing in mid 1962. This spacecraft will contain as many as six television cameras to photograph the clouds covering the earth and will also carry infrared equipment for measuring solar and terrestrial radiation. It will be launched into a polar orbit at an altitude of about 600 miles, permitting the cameras to photograph the entire earth in each 24-hour period.

We feel we are well along the way toward achieving for the first time in man's history the ability to make virtually continuous observations of weather phenomena over the entire globe, including the polar, oceanic, and desert areas that presently are not producing much significant data.

The use of satellites for world-wide communication looks equally promising. Here we have under investigation

two essentially different systems. The first of these is the passive reflector satellite, which carries no communications equipment but merely reflects the signal from a transmitting point on earth to a receiver at another point on earth, thus extending line-of-sight transmissions to intercontinental ranges. The other system is the active repeater satellite, which carries equipment to receive, amplify, and retransmit the signal.

Project Echo was a satellite of the first kind, a purely passive reflector. With it we have made communications history, as it has successfully demonstrated that a satellite can be used to transmit over very long distances telephone calls, teletype messages, facsimile mail, and photographs.

NASA is also undertaking the development of the first active repeater satellite designed to be able to receive and simultaneously rebroadcast communications -- the type which presently appears most promising for commercial use on a global scale. However, it is still uncertain as to which type of system will ultimately be the best, both from the economic as well as the technological standpoint. NASA will continue its research in both types of systems to demonstrate, to the extent possible, their technical feasibility and to make sure that the choice of an operational system is made on the most informed basis.

The potentialities of satellite communications are enormous and promise a virtual revolution in the fields of world-wide telephone, telegraph, and television transmission. I think the most significant indicator of the shape of things to come is the tremendous interest which a great variety of industries are showing in the new field of communications. In the telephone and telegraph areas alone, there appears to be virtual unanimity that satellite communications will provide a more economical means than new submarine cables for meeting the greatly increased demands for transoceanic services which can be anticipated during the coming decade. For the first time, world-wide television becomes foreseeable; and

entirely new forms of global communications, such as closed-circuit TV on an international basis, are made possible.

From this survey of our nation's space exploration program, I think we can all agree that one of its most striking aspects is the variety and diversity of activities that are in prospect. Whole new fields of scientific investigation are opening up. The frontiers of manned flight are being immeasurably pushed back, and space activities of immense practical benefit are already in sight. On the basis of what we know today, man can look forward, with justifiable hope, to an era of unprecedented scientific discovery and technological progress -- the era of the Space Age.

But there is another side to the coin, and it is a side with which lawyers should be particularly concerned. Today man looks outward toward space not only with hope but with fear. The new technology which can be employed for his benefit may also be used for his destruction.

What is needed is regulation and control -- a rule of law, and effective international organization for its administration. The needed controls should not shackle progress. If properly designed and properly administered, they should have the effect of freeing space for peaceful exploration, while reassuring the peoples of the world that their own safety is not being jeopardized by such activities. Today, much of the activity in outer space has an ambiguous quality about it which, if allowed to continue, may eventually have an inhibiting effect on all space exploration. If reasonable restraints are not imposed, unreasonable ones may be demanded.

The United States has made its position clear, both in the Disarmament Conference and in the General Assembly of the United Nations. It has proposed that there be prohibited by international agreement the placing into orbit or stationing in outer space of vehicles capable of mass destruction and that an international organization be given effective powers to determine compliance with

such an agreement by requiring prior notification of proposed launchings of all space vehicles and undertaking on-site inspection of such launchings. The Soviet Union appears not to be in basic disagreement with this proposal, but the whole subject has become entangled with the disarmament question. It remains a major problem for constructive statesmanship.

There are other problems of international organization and control relating to space activities which deserve attention. The United Nations Ad Hoc Committee on the Peaceful Uses of Outer Space, reporting in July, 1959, listed a number of these on which agreement is needed to insure the orderly conduct of space exploration. Among them are the proper and adequate allocation of radio frequencies for use in communicating with and among space vehicles; identification and registration of space vehicles, and coordination of launchings; avoidance of interference between space vehicles and aircraft, and possibly even among space vehicles; and protection of public health and safety, including safeguards against contamination of outer space or from outer space.

In addition to these problems of international organization and control, there are problems of a more purely legal nature which will require solution. Some of these involve primarily the extension or application of established legal principles to a new field of human activity -- space exploration. For example, liability for personal injury and property damage caused by space activities. Shall the disposition of such cases be governed by a rule of absolute liability, regardless of fault? Also, as another example, what should be the rights and obligations of the launching state and the host state in the case of unscheduled landings of spacecraft and personnel? Should the launching state have the right of immediate repatriation of personnel and repossession of the spacecraft, assuming that there is still something worth repossessing? These legal problems do not pose essentially new legal questions from the lawyer's point of view. Established principles and

rules are available for application; and it is perhaps not too difficult to predict the probable course of legal development in such areas, even in the absence of an international agreement specifically dealing with them.

On the other hand, there are some entirely new legal problems raised for the very first time because of space activities. I shall cite three of these. First, is there or should there be an upward limit to territorial sovereignty? Second, assuming such an upward limit, what is the legal status of outer space beyond it? And third, what is the legal status of celestial bodies? Are they or are they not subject to exclusive appropriation by any state on earth?

These three new legal problems are unavoidable, regardless of what may or may not be done about establishment of international controls over space activities. They should, in fact, not be confused with the subject of space controls.

Let us consider first the question of the upward or outward limit of territorial sovereignty. The 1944 Chicago Convention on Civil Aviation explicitly recognizes the sovereignty of every nation in the "air space" above its land and territorial waters; but it contains no definition of air space. The USSR is not a party to the Convention, but its own domestic law affirms the same principle. Because of this legal principle, every nation has the unquestioned right to exclude any foreign power, or the nationals of any foreign power, from entering its air space, and to specify the conditions on which entrance into and utilization of its air space is to be permitted.

Despite some of the arguments of the past, no one today seriously contends that such a rule should apply in outer space. During the past three-and-a-half years, numerous satellites launched by both the United States and the Soviet Union have repeatedly passed over the territory of every nation on earth. No permission

was sought in advance; none was expressly given by any state; and not a single protest has been registered by any state. It would appear that a new principle of international law has already been established by the actions of the great powers engaged in this activity and the unanimous acquiescence of all other states. This principle is that outer space is not subject to claims of territorial sovereignty, that no state has the right to exclude other states from the use of any part of it, and that it is therefore freely available for exploration and peaceful use by all. This does not mean, of course, that activities which threaten international peace and security are to be permitted in outer space, nor does it mean that a state is not free to take legitimate self-defensive measures in outer space. The extent of territorial sovereignty is not the criterion in judging such matters.

If outer space is free (and this principle was given cautious endorsement in June, 1959, by the Legal Subcommittee of the United Nations Ad Hoc Committee on the Peaceful Uses of Outer Space) while air space is subject to the sovereignty of the underlying states, the inescapable question for the lawyer is, "Where does the air space end, and where does outer space begin?" It seems to be generally conceded that air space ought to include everything as high as the upper limits of flight by vehicles deriving their support solely from the atmosphere -- that is, craft operating on purely aerodynamic principles. At the present time, such craft have ascended to only about 25 miles, but theoretically this can be pushed to perhaps twice that height, although it seems doubtful that it will be attempted. On the other hand, a satellite can orbit freely at altitudes of about 100 miles above the earth without encountering appreciable atmospheric drag. Below this point the speed is retarded quickly, and rapid descent occurs.

The United Nations Committee recognized this question of a boundary between air space and outer space as a legal problem but concluded in 1959 that it did not

demand priority treatment since no other legal or practical problems appear at this time to depend upon it for their resolution. My own opinion is that there is no good reason for postponing an effort to reach agreement on this question any longer. It is not the kind of question which will be answered by the accumulation of scientific knowledge or by further experience in the conduct of space activities. Speaking for myself, I think the boundary should be set lower rather than higher -- at 25 miles, for example -- rather than 100 miles, thus enlarging to the maximum extent the free, rather than the closed, portion of the total space over our heads.

By clearly delimiting the territorial air space at a relatively low altitude, we would remove once and for all the old bugaboo of sovereignty from the space above that altitude. Then, with a legal regime in outer space akin to that of the high seas, we could concentrate on what activities should, by international agreement, be prohibited in that area and what degree and form of regulation would be appropriate for those which are to be permitted.

Another legal problem that should be settled sooner, rather than later, concerns the possibility of claims to all or a portion of the moon or other celestial bodies. The United Nations Committee, in 1959, expressed the view "that serious problems could arise if states claimed, on one ground or another, exclusive rights over all or part of a celestial body."

The time is clearly ripe, I believe, for a forthright declaration by the United Nations that celestial bodies shall be deemed legally not capable of appropriation to national sovereignty. This is, in fact, the position which the United States has expressed in the General Assembly. Let us hope that this question will be settled before the competition gets too hot.

I should like to close by repeating a view I

expressed to the House Committee on Science and Astronautics two years ago:

"I think we must recognize that unless collective steps are taken to subject the exploitation of outer space to an orderly restraint, it is quite probable that fear, rather than hope, will dominate man's attitude toward these promising new developments, and that national security, rather than scientific advancement and the economic benefit of mankind, will keynote every new effort. It is the task of law and international organization to prevent such a disaster."