BULLETIN

THE AMERICAN INTERPLANETARY SOCIETY

113 West 42nd Street, New York, N. Y.

David Lasser, President | Clyde J. Fitch, Editor.

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SOCIETY HOLDS FIRST ANNUAL MEETING

The American Interplanetary Society is one year old. On Friday evening, April 3rd, 1931 the first annual meeting was held at the American Museum of Natural History, New York. Annual reports were rendered by the officers and new officers were elected for the ensuing year.

Mr. David Lasser and Mr. G. Edward Pendray were re-elected president and vice-president, respectively; Mr. Nathan Schachner was elected secretary; Mr. L. E. Manning was elected treasurer, and Dr. William Lemkin was elected librarian.

In the reports of the various officers, the growth and progress of the Society during the past year was stressed, and discussions and plans for the coming year outlined.

Abstract of the President's Annual Report

I suggest that the officers for the coming year consider two programs. The first is that we bring before the Society lecturers who are specialists in the various sciences associated with our aims and have them give us the benefit of their experience and knowledge. Another way to promote our knowledge of the specialized and more intricate problems is by continuing our own Research program. I suggest that the officers arrange for the continuation of our research on the rocket on the lines already laid down, this time getting closer to the heart of our problems.

On the second phase of our activities described in the Constitution as the "promotion of interest in interplanetary expeditions and travel, and the dissemination of information bearing on the subject." Our job, is to change the attitude of a nation on a project more immense than any that man has attempted; surely a gigantic task. The problem there is two-fold. One concerns the general lay public and the other concerns men of science. With regard to the first we have already made good progress. What we need is an expansion of the Bulletin not only in number but in contents- the type and diversity of material. The Bulletin is now in the files of twenty-five metropolitan libraries, it should be in seventy-five. Its size now is eight pages, it should be twenty-four pages with interesting diagrams and general as well as technical articles on the problem and how it is being solved.

In addition, we must ceaselessly hammer at the magazine and newspaper reading public with articles on every phase of our problem. There exists also need for a good book in English that shall cover the whole subject thoroughly.

The conversion of scientists and technical men however constitutes a more difficult and laborious process. We must literally make converts, if not members, of all the technical men that we meet; so that these men will be centers for the spreading of our propaganda among others. I come now to what is perhaps the practical end of our work that concerned with experimentation on the rocket.

I respectfully suggest the creation of a Committee on Experiments whose job it will be to 1. Decide where inexpensive but purposeful experiments can be made. 2. To lay out a general program for a series of experiments with costs. 3. To cooperate with research workers who wish to do experiments of their own and who solicit the Society's advice. 4. To advise the Society on how it may experiment to advantage on its own. This Committee can, I believe, be one of the most useful that the Society has, and I suggest that it be composed of men who have a personal flair for such work, and a practical sense of how it can be done. Another study that I believe should be begun immediately by the Executive Committee is what I would call a war campaign for the carrying out of our aims. I recommend that the Executive Committee lay out a program how, a given sum of money that might be provided by a man or woman or organization of means could be spent advantageously in promoting astronautics.

Another project that I recommend the Society bring to completion is the formation of an International Interplanetary Commission. I have already opened the way for its formation, and I believe that if it can be successfully accomplished it will do much to promote the fulfillment of our aims.

There should be an international press service where news on world developments will be gathered and translated into the various languages and disseminated to the various national societies. The International Commission would also cooperate in the actual fulfillment of our goals to the fullest extent possible. I can forsee the building of the first space ship only as a joint effort of an united earth.

M. Esnault-Pelterie and Professor Rynin of Russia already indicated their agreement to this project and we are approaching the German group to determine what can be done with them. But I mention the formation of an International Commission as one of the projects that the Society should consider as a means toward its goal.

I believe that if during the coming year we will energetically pursue the increasing of our membership, the broadening of our Research program; the extension of the Bulletin; the cooperation with experimenters, the formation of an International group and the sending out of articles for general and technical publications that we will have completed a good year in the interests of astronautics in America.

Abstract of the Vice-President's Annual Report

The Society needs members in order that its influence may be extended. Members make this possible in various ways. Each becomes a little nucleus of information on rocketry and astronautics. Members furnish the money necessary to carry on meetings and obtain speakers; they make the publication of an adequate and interesting bulletin possible, and finally ---though this may still be some time in the future---they may make possible a fund to be devoted to active experimentation.

The Society, so far as membership is concerned, needs to grow both outward and upward. We need associate members by the hundred, for on this foundation of interested supporters the organization depends for influence and strength. In addition we need a vigorous, informed and trained body of active members. In this division we should enlist, if possible, scores of men with technical educations and scientific aspirations, men who can and will experiment toward the solution of rocketry's innumberable problems, and who are willing to reflect honor upon themselves as well as upon the society by making important advances in this field. There is no reason why any of us should hesitate to invite our serious-minded friends to join an organization which already contains so many members of high calibre.

Because the aim of the Society is to popularize the idea of interplanetary flight and to educate the public, as well as to publicize itself, our publicity efforts have naturally been of a double nature. During the last year, because of the necessity for members, we have tried to bring the Society into our publicity as much as possible, and in this we have been unusually successful.

At one year old, the American Interplanetary Society has already attracted more attention, not only in New York but throughout the world, than many a wealthier and stronger organization succeeds in doing in ten years. It now ranks as an important scientific body in the minds of newspaper editors and readers, and as long as it holds that position we shall be listened to with respect and reports of our more important activities will be well received.

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NEWS AND VIEWS OF CURRENT EVENTS

Livable Temperatures On The Moon's Surface

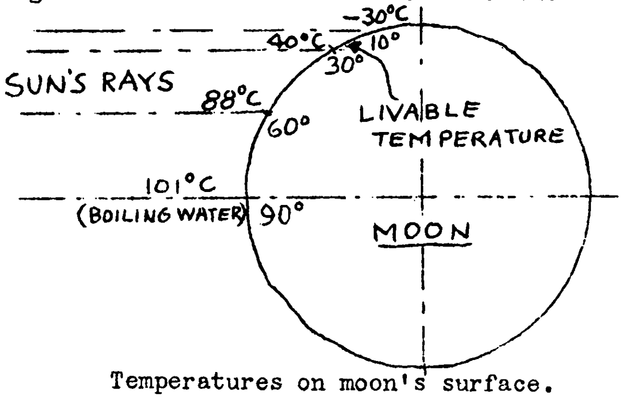
Some very interesting data on the moon's temperature appeared in an article in the April 1931 issue of the Scientific American, written by Henry Norris Russell, Ph. D. The results of the recent measurements made by Petitt and Nicholson at the Mount Wilson observatory, using very delicate and sensitive thermo-electric measuring instruments, together with mathematical deductions, are presented. These results may be summed up briefly as follows:

The hottest part of the moon, where the sun's rays strike the surface perpendicularly, is 101° C (214° F.).

When the rays fall obliquely they are spread out, and there is less heat received per unit area, while the radiating surface remains the same. When the rays strike at an angle of 60 degrees instead of 90 degrees, the temperature is 88° C.

When the angle is reduced to 30 degrees, the temperature falls to 40° C. And when the angle is 10 degrees, the temperature drops to -- 30° C, or 22° below zero Fahrenheit.

Observations made during the lunar eclipse show that the surface cools very rapidly as the sun's rays are cut off. A part observed before eclipse had a



Temperatures on moon's surface.

temperature of 60° C. One hour later, when the last rays of direct sunlight had just been cut off, the temperature was --100° C. During the two hours of totality there was a low decrease to -- 117° C (-- 180° F.). The coldest temperature existing during the long lunar night is calculated to be about -- 150° C. Only a very light and porous material, such as volcanic ash or pumice, would show the phenomens that the moon's surface actually does.

The illustration shows the various temperature regions on the moon's surface. It is interesting to note that a comfortable summer heat exists when the sun's rays fall at an angle of 25 degrees; and a person walking leisurely could easily follow the setting sun and always remain in this region of comfortable temperature.

Moon Charged With Negative Electricity

The theory that the moon contains a negative charge of electricity (with respect to the earth) was recently advanced by Dr. Harlan T. Stetson, astronomer, director of the Perkins Observatory at Ohio Wesleyan University. He noted that radio reception is weakest when the moon is directly overhead, and strongest when the moon is at the opposite side of the earth. This effect he explains by the theory that the stream of electrons from the moon depresses the Heaviside layer, resulting in weaker radio signals.

Moon Flight

The following editorial on "Moon Flight" appeared in the New York Herald - Tribune, Saturday, Jan. 31, 1931:

The American Interplanetary Society is an attractive organization with a romantic name. Merely flying about through the air is already getting to be a somewhat dull business; and who can fail to applaud this first mobilization of interest in the far more breath-taking projects of "astronautics"--the navigation of the solar system, if not ultimately of interstellar space. The pictures which it evokes of pioneer rocket pilots watching the earth receding or nerving themselves for the hair-raising arrivals upon the moon have all the fascination of the works of Verne or Wells, tinged with an even stronger color of scientific possibility.

Theoretically, indeed, the matter has been pretty thoroughly studied out; nearly every difficulty has been solved (except the trifling one of how it is to be done) and with the exercise of only a little imagination we can already see ourselves upon the threshold of space--the mysterious world into which we daily gaze, but which no human being has ever penetrated.

It is theoretically possible to fling a projectile out into space, cause it to circle the moon under the latter's gravitational influence and return to earth--if it can be given sufficient initial velocity and its flight can be controlled. By way of a beginning, the even less difficult experiment could be tried of chucking a rocket car out beyond the earth's atmosphere, leaving it to circle there perpetually as an artificial satellite.

No object has ever yet left the earth never to return. But the shells of the German long-range gun in 1918 reached a point twenty-four miles above the earth's surface at the top of their trajectory. They were fired with a muzzle velocity of 5,000 feet a second; in other words, they were traveling about twice as fast as ordinary heavy artillery projectiles when they departed. The moon rocket will have to attain a velocity of more than 13,000 feet a second; though the acceleration will be slower than in a gun, the speed will be two or three times that of the fastest traveling shell.

Its crew will have to be men of iron to stand the shock of the discharge, and men devoted to science, moreover, since in the early stages of the art it is improbable that a rocket can be built carrying enough fuel to leave the moon once it has landed there. However, we may be forced to something of the kind. J. B. S. Haldane has played, in one of his lighter moods, with the idea that since the moon is some day destined to fall into the earth, mankind, if it is to save itself, will have to solve the problem of a mass migration to Mars or Venus!

New High Speed Camera May Aid Rocket Design

Traveling at the effective rate of 2,160 miles an hour, the film of a new motion-picture camera invented by Baron Shiba, Japanese scientist and director of engineering of the Aeronautical Research Institute of Japan, may reveal secrets of air currents and bullet flight that will be of inestimable value in rocket design. The new camera takes pictures at the rate of 40,500 per second. No shutter is used; the lens remains wide open and illumination is effected by means of a high-frequency spark discharge. In reproducing pictures taken with the camera, the fastest bullets used in the Army today (which attain a velocity of two thousand miles an hour) will appear to leisurely crawl across the screen.

The attainment of such tremendous film speeds is a noteworthy achievement, in view of the air frictional resistance encountered.

Acceleration Of The Human Body

One of the unsolved problems connected with astronautics is the determination of the maximum amount of acceleration that the human body can stand. Writing in the World,(New York) Feb. 22, 1931, Don Glassman gives some very interesting data on this subject.

"Speed pilots gradually grow accustomed to the effects of high velocity," writes Mr. Glassman, "provided they work up to the maximum gradually. On a straight line of flight, the hazards are much lower than if one turns. The heartbeat is accelerated, and often blood rushes to the nose.

"The modern racing pilot banks his ship almost at 90° to make a 180° turn. The visible effects of this ordeal are shown by black and blue marks over his body..... On rapid turns the pilot may lapse into unconsciousness for a moment. Centrifugal force takes blood from the eye, but sight returns as soon as the turn is completed. A sinking sensation affects the pit of the stomach, accompanied by dizziness. Blood rushes from the head to the center of the body, or to the legs... The best flight surgeons hesitate to guarantee anything beyond 300 miles. Safe speed on a straightaway may possibly be as high as 500 miles per hour.

"It is not rash to state thet racing pilots are approaching a speed when a sharp turn will press the brain stem to the point of death, Furthermore, the violent concussion would rupture blood vessels in the brain, as well as other parts of the body.

"Tingling of the scalp, ballooning of the cheeks and rattling of the teeth are accentuated at high speeds. A pilot's arm would at least be broken if he were to hold it out at a speed of 250 miles per hour; and if he dared to lift his head above the cowling it would be knocked over and his neck probably broken. R. L. Archerly, of the Royal Air Force, actually looped the loop at 300 miles per hour, and topped off the performance with a perfect barrel roll."

In conclusion, Mr. Glassman states that it is doubtful whether the brain, nerves and muscles could co-ordinate on speeds above 400 m.p.h. At 500 miles per hour, the engine metals would become red hot, due largely to air friction.

Rocket Motor Drives Ice Boat

Harry W. Bull, twenty-one year old Syracuse University Student, successfully applied the principles of rocket propulsion to an iceboat on March 9, 1931. The boat was sent fifty feet over the mushy ice of Oneida Lake in two-fifths of a second. The test showed that the rocket iceboat was capable of traveling at a speed of about 75 miles an hour.

Two fellow students stood at the tail of the craft, gave it a quick push and leaped back as Bull threw the switch that set off the first battery of rockets. The boat leaped forward, swerved from a narrow shoveled course and plowed into the snow that clogged its runners and swung it around like a pinwheel. The experiment was unusually successful, in view of the fact that the total expenditure for the equipment was $22, $15 of which went for the rockets and fuses.

Seventeen Ounce Radio Transmitter

Rocket experimenters who are planing to send test rockets into the upper strata will no doubt be interested in the miniature radio transmitter employed by the Signal Corps for similar experiments. This transmitter, according to Colonel Arthur S. Cowan, consists of a complete sending apparatus, including radio tube and flashlight battery. The whole thing weighs only 17 ounces. As it is carried upward by a cluster of small hydrogen-filled balloons, a radio direction finding receiver is employed to tell the direction and velocity of the winds at various altitudes above the earth's surface. The information thus gained is of inestimable value to the Air Corps and to the Artillery.

No Oxygen In Moon's Atmosphere

As a result of his measurements of the spectrum of moonlight, Dr. Brian O'Brien of the University of Rochester has definitely proved the nearly complete absence of oxygen in the moon's atmosphere. This conclusion was recently announced to the American Physical Society.

The test depends upon the presence of ozone, a form taken by some of the oxygen in the sun's light. Ozone is opaque to ultraviolet light of certain kinds. As no differences can be observed in the strength of these colors in the light reflected from the surface of the moon, as compared with light direct from the sun, the absence of oxygen on the moon is shown.

The test is not interfered with by the presence of ozone in considerable quantities in the earth's atmosphere; as the amount remains practically constant during the night.

The Future of the Rocket

For some real straightforward information on the future of the rocket, one can do no better than read Mr. Lasser's article in the March 1931 issue of the _Scientific American_. In this article the practical aspects are considered, strictly from a scientific and engineering point of view, but without delving into deep theory or mathematics. It is written with a view of keeping in mind the practicability of the project of interplanetary flight. Many figures and facts covering the actual work that has been accomplished here and abroad, as well as the work now in progress by Professor Goddard and others are fully and clearly explained.

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EQUIPMENT FOR AN INTERPLANETARY EXPEDITION AND METHODS OF STEERING,

(Abstract of a report- by Nathan Schachner to the American Interplanetary Society at meeting of Jan. 1931, in work under research program.)

While much has been written about the mechanical construction of a rocket for flight into interplanetary space and considerable attention has been given to the all important question of fuels for the motive power, there is practically nothing in the literature of the subject relating to the actual pay load of an actual rocket in flight.

In former discussions on the construction of the rocket, it was pointed out again and again that with maxium efficiency of present day fuels, almost five hundred pounds of fuel for each pound of pay load would be required. Hence it is of vital importance to cut the pay load of the rocket to the barest minimum of weight and that only the strictest essentials and the lightest possible equipment be included.

I shall assume, as the lower limit for an expedition, that is to have any chance whatsoever for ultimate success, a pay load of ten tons. I shall further assume that the minimum interior space requisite for the expedition to be a compartment of ten foot diameter. And still another assumption - that the shell and fixed equipment weigh 6 tons, leaving only 4 tons for actual pay load.

As to the crew themselves, I believe that three men represents the irreduceable minimum. Clothing would be of the usual type requisite for terrestrial polar expeditions, with an additional supply of normal every day clothes for use in the ship. The weight of the three men would average five hundred pounds, and their clothing at the outside another hundred pounds. The first essential for the continued existence of the crew is of course that of a sufficient supply of atmosphere fit for breathing.

It will take about three terrestrial days for the journey to the moon and back and at least an additional three days for hasty exploration, making a total of six days in all. The method of supplying air in the interior of a sealed compartment has been experimented upon at length within submarines. Cylinders of liquid oxygen under pressure are employed and the oxygen sprayed into the compartment through carefully regulated nozzles, as the need for it arises. The carbonic acid gas exhaled by human beings is absorbed in finely powdered dehydrated soda lime and calcium chloride.

Our latest type submarines are able to stay under water for a duration from sixty-four to seventy hours without much discomfort, before the supply of air runs low. Weight being an all important factor, the expedition could take along only the absolute minimum of oxygen supplies. It has not yet been definitely proven just what the effect of an almost pure supply of oxygen in the latter stages of the journey would have upon the human being. It must be remembered that there will necessarily be some leakage of the air within the rocket during the flight; notably upon landing and the return to the ship, and that therefore the inert nitrogen content of the air would gradually be dissipated. We do know that human beings live faster and incidentally burn up faster in an atmosphere of pure oxygen; and the extended period that the crew would be compelled to live in such an atmosphere might have extremely deleterious effects upon their systems. On the other hand they might return in a state of almost indecent exaltation with minds and bodies racing at full capacity. Control experiments with volunteers submitting themselves to a continued residence in pure or almost pure oxygen could very easily determine this point in advance.

The weight of the oxygen, the tanks, and the soda lime and containers would easily run to one thousand pounds.

The next most important item on the journey would be food supply. The most nourishing food in the smallest compass and least weight is indicated. Fortunately in this day and age of vacuum cooking and canning of every conceivable foodstuff, it would be easy enough to make up a list of tinned meats, concentrated juices, and vegetables as well as a plentiful supply of biscuit to last out the journey. Figuring three to five pounds of food stuff to each man per day of journey, the total amount of food carried would weight approximately not over one hundred pounds.

The next most important item of supply on the expedition would be water. Figuring two quarts of water per man per day, as the minimum for reasonable subsistence, the weight of water to be taken along would amount to seventy odd pounds.

As for the actual scientific instruments that are necessary, there must of course be a telescope permanently inbedded in the walls of the rocket chamber. It is advisable that a very thick quartz window of absolute transparency be superimposed over the lens of the telescope to withstand the possible impact of meteors and at the same time allow for an equable temperature within the telescope tube. A refracting telescope of five inch aperture is indicated, with two eye pieces, giving magnifications of one hundred twenty-five and two hundred diameters, as well as a removable dark glass cap for sun observations. Such a telescope need not be more than five to six feet long and weigh more than fifty to one hundred pounds. A table type spectroscope with superimposed comparison spectra weighing no more than twenty pounds is essential.

A microscope with good solid base, possessing three lenses with 100, 240 and 400 magnification, substage illuminator and iris diaphragm would be useful for investigation of possible elementary forms of life. A good standard compass would be extremely useful to determine the magnetic poles of the planet visited, as well as to gain some conception of the magnetic fields in outer space.

A sextant would be necessary to take bearings during the course of the flight. The fixed points for computations would necessarily be the sun, the earth and the moon. A chronometer would be absolutely essential, inasmuch as no navigation through space could be effected without a knowledge of the time of flight.

Thermometers would of course be necessary. The usual mercury thermometers for the regular earthian range of temperature; toluol filled thermometers for temperature ranges of -100°C. to x 50 C. and pentane filled thermometers for temperature ranges of -200° C. to x 50 C. A hygrometer would be useful for determining the water vapor saturation in the atmosphere of the planet visited.

A light compact motion picture camera, with the necessary film and equipment would be a valuable adjunct to the expedition. An absolute pressure gage would be useful to give the amount of atmospheric pressure on the planet visited. Such a gage is not an ordinary barometer which would merely give pressure in terms of sea level atmosphere, but gives direct readings in terms of absolute pressure.

Space suits would of course be absolutely essential if exploration on the moon or planets is to be considered. By a space suit I mean an equipment somewhat similar to a diver's suit made preferably of a light rigid metal with flexible joints, to which would be attached a helmet so as to completely enclose the wearer. The suit would have to be air-tight and water-tight and most carefully sealed against possible leakage. The suit must contain a small oxygenation apparatus for breathing purposes and a flap for exhalation such as was a feature of the gas-masks used during the late war. Air at terrestrial barometric pressure would be pumped into the suit to avoid the terrific internal expansion pressure of the human body in a vacuum. For moon use, leaden weights should be attached to the shoes to adjust for the lighter force of gravity.

There is one item which would be essential in the equipment of this space ship, on which research work would have to be done, and that is a method of measuring the velocity of flight of the ship.

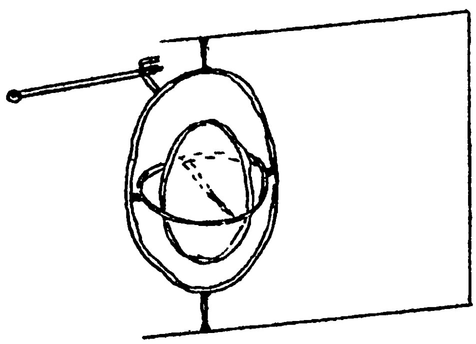
I am not going to discuss methods of maintaining an equable temperature within the rocket compartment, as that is a very simple affair in the light of present day knowledge, except that heating apparatus employed must be of the lightest possible weight.

We come now to a consideration of apparatus to be installed in the rocket ship for steering purposes. On the outer body of the rocket would be placed four fins at right angles, to obtain some measure of stability while the rocket is traversing the earth's atmosphere, but these fins, while somewhat helpful, would be insufficient as a very slight deviation from the appointed course at the beginning of the flight would cause the rocket ship to miss the moon by many thousands of miles and the projectile with its doomed occupants would probably become a satellite of the sun.

Several methods have been suggested, the most notable of which is the gyroscope. Let us consider for a moment the construction of the gyroscope as we know it to-day in use in the Whitehead Torpedo. This torpedo uses the Obry Device.

A small flywheel rotates with high velocity about an axis parallel to the length of the torpedo. The ring holding its axle turns about a horizontal axis in an outer ring, and this outer ring turns about a vertical axis which is fixed to the torpedo. On the outer ring is a pin which engages the forked end of the lever.

If the torpedo turns sideways, the flywheel maintains its place until one side or the other of the fork is brought against the pin. The action of the fork on the gyroscope is to move it slightly about a vertical axis, but due to the high velocity of the disc, the resulting gyroscope couple turns the flywheel about the horizontal axes, and this reacts against the fork. In other words, the lever has to act against what is a high rotational inertia. Since the lever is easily movable, it turns the outer ring only slightly, the inner ring considerably more, while it is itself freely turned by the reaction. It opens an air valve by which compressed air turns two horizontal rudders, thus bringing the torpedo back to its course. If the torpedo deviates to the other side, the lever is moved in the opposite direction and the rudders work so as to oppose this change.



GYROSCOPE

Now if we substitute for the cylinders of compressed air in the submarine or torpedo, small cylinders of fuel; and if we have the gyroscope contact make an electrical circuit which would explode the fuel placed conveniently on either side of the rocket ship, then we have adapted the Obry Device to our specialized use. Any deviation from the true course, would cause a contact, explode the fuel, and the emission of gas would throw the ship back to its true course.

It has also been suggested, that vanes be placed in the rocket stream, so that the pressure of the emitted gases against the vanes would true up the course.

It has been further suggested by some authorities that a series of photo-electric cells could be installed, adjusted to a certain definite reaction to the direction of light from the sun. It is said that any change in the quantity of light received by reason of a swerving from the true course would have an instantaneous effect upon the cells, setting up an electric impulse which would close a circuit and cause corrective rocket discharges to be emitted.

The sanest and simplest solution would be to have corrective rocket outlets on all sides of the rocket ship, fed by small tubes of solid fuel, which could be exploded by the crew at will. This presupposes of course, that the crew, during the flight, would be able to make the observations and mathematical calculations necessary to ascertain their position in space at any particular moment of time. With our present knowledge, this is extremely doubtful.

A parachute equipment could be installed in the nose of the projectile, folded and able to be released mechanically by the crew.

Leaving now the questions of equipment, I am going to discuss a problem, suggested to me by Mr. Lasser, and which is of great scientific interest, to wit, the question as to whether or not man could live for any duration of time in outer space or on the dark side of the moon where conditions approaching that of outer space are approximated.

Let us first consider the conditions existing in interstellar space. To the best of our knowledge, it is an almost perfect vacuum. Professor Eddington has calculated that on the average there is not more than one atom per cubic inch throughout space, which makes for an order of density of almost inconceivable tenuity. The best vacuum that we are able to obtain in the scientific laboratories contain nevertheless several million atoms to the cubic inch.

And now arises a further seeming paradoz. Professor Eddington very blithely estimates the temperature of outer space as around 15,000° C. This astounding figure is very easily explained. It represents merely the heat energy of the atoms existent in space. A terrestrial thermometer would show a temperature of only about 3° C. above absolute zero, inasmuch as there would not be sufficient atoms impinging upon the thermometer to make any appreciable difference. Accordingly, for our purposes it must be considered that the temperature of interstellar space ranges from absolute zero to 3° C. above.

Now let us assume that a human being is ejected from a rocket ship on its initial flight to the moon, clad only in an air-sealed diver's suit made of some rigid material with flexible joints to allow freedom of motion, and a diver's helmet clasped firmly on his head. The interior of the suit would be filled with air of normal atmospheric pressure. Another item of interest in connection with the necessity for space suit is the question of rapidity of evaporation of moisture from the human body if exposed without cover to the vacuum of space.

An article by Frank E. Lutz, Curator of Insect Life, American Museum of Natural History, in the Scientific American of October 1930, gives the results of experiments with insects within a vacuum. He states that the difference in pressures caused the natural moisture of the insects to be drawn out of their bodies almost immediately and that it appeared in the form of solid particles of ice within the vacuum jar.

To return to our problem of the man thrown out of the space ship. If he were exposed to the rays of the sun, the fierce radiation beating upon him without any modifying influence of atmosphere, would be of the order of the temperature of boiling water. If he were floating on the opposite side of the ship, in other words, shielded from the rays of the sun, he would be immersed in a vacuum whose temperature is not more than 2° or 3° C. above zero.

In order to calculate just how long man could live under these conditions, we shall assume that he weighs 150 pounds, and that he possesses a surface area of 20 square feet.

Furthermore, it is the consensus of medical opinion that a drop in the body temperature of 10° F. would mean almost immediate death. Therefore our problem is to discover just how long it will take for the human body at a normal temperature of approximately 100° F. to lose 10° F. in body temperature, when subjected to the absolute zero of space.

Man's body as a matter of fact is a very imperfect radiator and the results obtained by a 'Black Body' calculation, would have to be doubled or tripled to obtain the proper final result. In calculating the B.T.U. emitted by a man's body, estimated at 20 square feet of surface, we obtain 3,200 B.T.U. per hour, or 50 B.T.U. per minute.

Inasmuch as B.T.U. is a function of mass, we must divide this result by the weight of the man, to wit, 150 lbs., and we obtain a result of 1/3° F. per minute. Interpreting this result, we find that a perfect 'Black Body' radiator of the mass and surface area of a man would take 30 minutes to lose 10° F.

Now as we have said before, man is not a perfect radiator, so that we must multiply this result by two or three to get a fair approximation as to how long it would take for a man under the conditions and in the environment indicated, to lose sufficient heat to cause his death. We find therefore, that it would take from one hour to one and a half hours for man to succumb. And this does not take into consideration the heat generated by the action of the heart.

The implications of this seemingly simple statement are tremendous. Heretofore it has been believed that an expedition to the moon, even though possible through the perfection of rocket ships, would be suicidal because man could not live for more than an instant upon the surface of the moon in its airless, waterless condition.

We are led to the conclusion however, that there is no inherent impossibility involved in man's colonization of the moon.

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THE EXPERIMENTAL ATMOSPHERIC ROCKET

(Abstract of report by L. C. Lee, Jr. to the American Interplanetary Society at meeting of February, 1931, in work under research program.)

The subject of this paper is a brief discussion of the experimental atmospheric rocket. By this is meant a rocket that will ascend without passengers from 50 to 200 miles and bring back various data. For the purpose of this paper a height of 100 miles has been used as the figure to be attained.

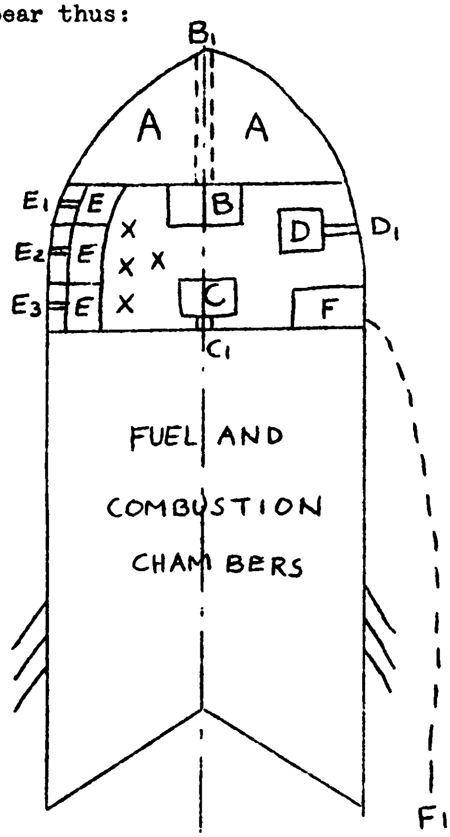
The greatest height to which man has ascended is about 8 miles. Small balloons carrying instruments have gone somewhat further. To a height of about 10 miles we know the secrets of the atmosphere very accurately. Above that our knowledge is extremely limited. It will be the function of the experimental rocket to give us the knowledge of what is beyond the 10 miles we now know.

The first requirement of this rocket experiment will be a section of the country where the air is generally clear and dry. Arizona or New Mexico, where I believe Professor Goddard is at present experimenting with such a rocket, under the Guggenheim grant, would be ideal for this purpose. Hazy conditions in the atmosphere due to excess of water vapor would be fatal to our photographic hopes. So would an excess of dust, therefore a clear day following a rain would be ideal. The rocket itself will be one of the conventional types, its size being regulated by the following requirements:

(1)	Weight of instruments, etc.,	- 40 lbs.
(2)	" " parachute -	- 21 "

The rocket itself, of the lightest materials possible, will weigh, as nearly as I can figure, about 180 lbs. The fuel required to lift this total of about 240 lbs. to a height of about 100 miles above the earth's surface, will run between 500 and 1000 lbs. It is impossible to be more definite on this figure as none of the present experimenters will give their findings on new fuel combinations. I have not attempted, in this paper, to go into the construction of powder chambers, types of fuel, etc., as they have all been very fully covered by previous speakers.

The completed rocket will, in section, appear thus:



NOTE: NOT DRAWN TO SCALE

The space marked XXX is used for the electrical timers and the storage batteries to run the apparatus.

In the upper portion of the rocket marked "A", we see the parachute for its descent. In the next section, "B", we have a camera run by electricity, to take pictures of the sun during the ascent of the rocket. The lens is mounted at the upper end of tube "B", and the camera proper is at "B". The other camera is at "C", with lens at "C". This is to take photographs of the earth's surface during the descent of the rocket. "C" will not operate until the top of the flight has been reached, and the descent begun. At this point, the following events occur:
An electric timer, drops the powder chamber and combustion apparatus. The parachute is opened simultaneously.
The powder chamber being out of the way, lens "C", is clear and camera starts working. "B" camera, which is now useless, owing to the intervention of the parachute stops at this same time.

The cameras will be standard airplane type, electrical drive, taking about 4 x 5 photos. "B" camera will take a photo of the sun every two seconds, since the rise will be so rapid. "C" camera will take a picture every minute for the first hour of the drop, which will take in all about two and one half hours.

The cameras will use panchromatic films, and 2 X or 3 X Wratten filters, to cut out haze and give correct color values. The lenses will be quartz, so that they will not be affected by the terrific changes in temperature that will occur. The mechanisms must be insulated against cold to prevent sticking. We should thus get fine telescopic photographs of the sun without atmospheric interference, and photos of our earth, using a wide-angle lens, showing an erea up to 200 miles by 400, or 80,000 square miles.

The next instrument is the recording thermometer. This will be mounted at "D", taking constant readings of the temperature of the outer air thru tube "D". These readings are recorded on the revolving drum of the apparatus.

The next instrument is at "E", - probably the most important of all. It gives us samples of air pressure and air for chemical analysis at different points during the drop. The apparatus is this: a highly exhausted vessel ends in a thin walled glass nozzle at point "E", - another tube leading to the outer shell of the rocket. The end of this tube is sealed and wound at the proper spot with a few turns of platinum wire. At the proper time, the tip of the tube is broken; air rushes into the exhausted vessel. A second later the platinum wire is short-circuited electrically, it melts the end of the nozzle, and the tube is sealed once more. A series of these vessels, allowing samples of the air to be taken every few minutes of the descent, is shown at E, E_2, E_3, etc.

In addition to these instruments, we can, if we wish, mount a silver disk pyrheliometer for measuring and recording the intensity of the sun's radiation in a chamber and tube next to "B".

Lastly, we have a short-wave radio sending set, of a total weight of less than 10 lbs. with batteries, at space "F", aerial at "F". This radio serves a double purpose. It will send a constant signal, and observations will determine the fading, etc., as it approaches the Heaviside layer, so much a mystery to the radio world. Its second purpose is even more important, - to permit us to know where the rocket lands.

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NEWS FROM ABROAD

Liquid Fuel Rocket Rises 1000 Feet

A test rocket made a successful flight on March 14, 1931, at the military training grounds at Gross Kuehnau, Dessau, Germany. It reached a height of about 1000 feet and landed 600 feet from the starting point. The rocket, designed by a former Junkers engineer, Johannes Winkler, was two feet long and one foot in diameter, and propelled by a mixture of liquid oxygen and gasoline, which was ignited electrically from a distance of 150 feet. The body of the rocket was distinctly discernible during flight.

German Rocket Rises With Scientific Instruments

On March 13, 1931, Karl Poggensee, German aviation engineer, in tests near Berlin, successfully shot a rocket carrying scientific apparatus 1500 feet into the air. The rocket carried an altimeter, cameras, apparatus for measuring the rate of speed, and a parachute. The rocket was made chiefly of aluminum. It rose from level ground with perfect ease, and the parachute brought the instruments down intact.

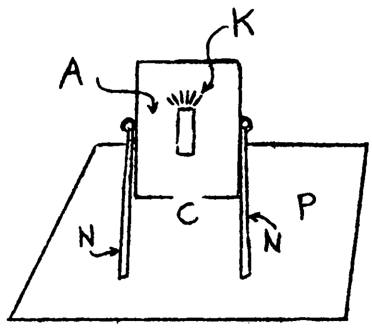
Light Weight Rocket Motor Developed In Germany

A motor which may revolutionize long-distance airplane flying has recently been developed in Germany by Dr. Paul Heylandt. This motor weights only 14 pounds and delivers 200 horse power. The motor uses a continuous stream of liquid fuel energy, the fuels being mixed at the correct proportions automatically. The motor is the result of improvements and perfections of the apparatus employed by the late Max Valier, last year. Materials have been improved to a point where the machine is safe and will not blow out; as it did at the fatal experiment in which Valier was killed.

Rocket Flying Machine 50 Years Old

While the use of rockets may date back to the 13th century, (See "History of the Rocket", by G. E. Pendray, Bulletin No. 5.) the rocket flying machine, according to a letter received from a correspondent, Dr. James Perlmann, of Leningrad, was first proposed in 1881 -- 50 years ago. The author was the Russian revolutionlist, Nicholas Kibalchich, the man who prepared the bombs that killed Emperor Alexander II.

A few days before being executed, Kibalchich submitted his scheme for a rocket flying machine to his defender. From 1881 to 1917 -- the year of the Russian revolution -- the project remained in the archives of the police; for 36 years nobody knew what subject was discovered in the writing of the executed revolutionist. And when Constantin Ziolkowski, a contemporary Russian inventor, appeared (in 1903) with his theory of the rocket flying machine, he had not the least suspicion that 22 years before almost the same idea had been proposed by a countryman.



Sketch of the first rocket flying machine.

In the sketch of Kibalchich, reproduced herewith, A is a metallic cylinder in which compressed gunpowder burns. It is supported on a platform P by means of the supports N N. The exhaust passes out through the hole C in the lower end of the cylinder and through another hole (not shown in the original sketch) in the platform. The pilot is supposed to be on the platform. The calculations, founded on the formulas of Ziolkowski, show that, assuming a weight of one ton, Kibalchick's engine could be supported in the atmosphere on the condition that 20 kg (44 pounds) of gunpowder would be consumed in one second!

Oberth's Air Rocket

Further details of Professor Hermann Oberth's air rocket which he described in a lecture in Vienna (an account of which appeared in Bulletin No. 7.) appeared in a recent edition of the London Observer. For his rocket he uses benzine in a fluid state. The empty rocket weighs somewhat more than 17½ pounds, and five times as much after being filled. Special mechanism renders it possible for the rocket to reach a speed of nearly two miles a second, and a distance of 650 miles. This rapidity may be increased by placing one or several smaller rockets on the main one. The Professor holds that letters could be sent to the United States within half an hour, and the cost would be only four to eight times as much as is now paid.

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UTILIZATION OF THE ROCKET

(Abstract of a report by Adolph L. Fierst to the American Interplanetary Society at meeting of March 20, 1931, in work under research program.)

Previous reports have dealt with the mechanical problems of sending a rocket into space; with fuels, construction, costs; the difficulties of overcoming gravity. The report preceding this discussed the robot rocket which, when sent up unmanned, would bring back valuable information concerning the physical properties of the upper atmosphere. But such a rocket is merely a preliminary step; a means to an end. We shall, perhaps,attain the ultimate development of the space rocket when we are able to send aloft a mechanism, adequately staffed, which will remain in space as long as we desire.

By means of the step-rocket, the desired height will be attained within a very short time. Then, in order to prevent the vehicle from going farther out into space, the rocket is gradually turned by explosions concentrated on one side so that its course will be parallel to that of the earth, and it will be traveling in a circle having as its center the center of this planet. Since the rocket has already reached its velocity of five miles per second, there is no necessity for wasting more fuel. With the power shut off, the rocket ship will continue on its course around the earth, its initial speed having given it the velocity necessary to remain within the gravitational sphere of our planet and to keep from falling back upon it. With the centrifugal force of the revolutions exactly balancing the direct pull of gravity, the rocket, once it has assumed its position as a satellite, might very well remain that for all eternity, circling the earth as long as the earth exists.

Because of the absence of atmosphere, there will be a complete absence of friction; the rocket will travel in an orbit as fixed and steady as that of the moon. We will be able to observe it from the earth and chart its progress like any other heavenly body and knowing that it will make one complete revolution of the earth every hour and three quarters, approximately, (in an orbit of 28,260 miles at 5 miles per second) we shall know where it is at any moment of the day or night. This knowledge, as we shall see later, will be most useful when we wish to turn the rocket to practical advantage by transforming it into a supply station or into an observatory which will tramsit its findings to other space cars which intercept its orbit,

Against the sun, the usual protection is to have one side of the rocket brilliantly polished, in order, as far as possible, to reflect the heat rays back into space. Coating with aluminum paint might be useful, according to the United States Bureau of Standards. Aluminum paint, used on the roofs of army huts and tents in tropical climates has reduced the temperature inside these palatial edifices as much as twenty degrees. But when a temperature of more than two hundred degrees is to be reckoned with, a mere twenty means little. Therefore, a combination of brilliant polish and aluminum paint may very well turn away the heat that will be unwelcome, and still allow sufficient heating to warm the rocket to a comfortable state. It will be unnecessary for the craft to return to earth. All water and oxygen, food and supplies will be brought to it as it follows its orbit--by a rocket ship identical with it.

Quite naturally, the first use of the observation satellite will be for astronomical investigation. An observatory in space, undimmed by any atmosphere, is the astronomer's dream--a dream he has tried to make actual by building huge telescopes on mountain tops, where the air is clearest.

In Bloemfontein, South Africa, some excellent work is being done with a twenty-six inch reflecting telescope; but that, also, would be far too large for rocket transportation. Obviously, what is necessary is a small telescope with powers of light-gathering and penetration entirely out of proportion to its length and weight. For the solution of this problem there are, at present, three possibilities:

The first lies in the new type of telescope perfected recently by Professor G. W. Ritchey, one of the world's foremost astronomers, now working at Mount Wilson. This instrument is particularly adapted for celestial photography, since it will eliminate entirely the distortion of out-of-axis images and still retain proper focus on the central image. The entire plate will be microscopically sharp. The Richey Chretien twenty-inch telescope, as it is called, has a clear aperture of 19.9 inches, and,--here is where its great advantage lies--the tube is only 54 inches in length! Nevertheless, it has a focal length of 136 inches which in an ordinary refracting telescope, and taking into consideration the width of the aperture, would necessitate a tube length of 32 feet.

Another means of overcoming the difficulty lies in the new high-speed lens developed by W. B. Rayton of Rochester. This lens will double the spectrographic power of any telescope. Already it has given the hundred-inch Mount Wilson telescope the spectrographic powers of the 200-inch instrument now being constructed; and it will give this one the powers of a 400-inch telescope.

An illustration of the penetrating power of the new lens lies in Dr. Hubble's report that, by means of it, he has been able to estimate the limits of Creation at 10 followed by 33 zeros--in light years.

In connection with these telescopic improvements we may mention a new lens designed by F. E. Ross of the Yerkes Observatory, which is still another improvement for celestial photography. It cuts off the diffusion of long streaks of light (for example, the fuzziness of cometary tails) in photographic images not near the center of the parabolic mirror. But its real use, as far as the rocket is concerned, lies in its ability to extend the accurate center field of the telescopic mirror to three times its diameter, thereby increasing the size of the field of vision nine times.

But perhaps the best solution to the problem of the rocket telescope lies in the statement of O. H. Caldwell, editor of "Electronics," who predicts the development, in the near future, of the electronic telescope, which will be smaller, simpler, and much more powerful than what he calls the "crude and massive monster of modern observatories--which have shown no technical improvement since Galileo." The electronic telescope will depend upon the amazingly sensitive photo-electric cell in the lens.

Coming closer still to the earth itself, we have the matter of observations that can be taken directly upon it. Our planet, almost completely mapped as it is, is still something of a mystery. From a height of 500 miles the observer will be able to survey a circle with a radius of 1875 miles; or an area of about eleven million square miles. He will be able to observe, at once, the continent of North America from Hudson's Bay to the Gulf of Mexico, and from the Atlantic to the Pacific. Or, in his search for atmospheric disturbances, he will be able to watch the Atlantic from the shore of America to the shores of Europe. Tornados, rainstorms, ships in distress--all will come under his field of observation. At a distance of five hundred miles even heavy clouds will appear as mere flecks; and the location of dense clouds formations will be radioed to the proper stations.

Already practical engineers are looking to this achievement. We learned recently that the Junkers company of Germany had designed a "stratosphere" plane designed to fly at 40,000 feet with a speed of more than 500 miles an hour, thus making possible a flight between Berlin and New York in six hours.
