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SOME SUGGESTIONS AS TO EXTERNAL AIDS TO ROCKET FLIGHT

(Abstract of a report by Laurence Edward Manning to the American Interplanetary Society at meeting of October 9, 1931.)

It is possible today--and barely possible--to design a three-step rocket with sufficient power to leave the earth for a considerable trip. With more powerful fuels we all hope to see rocket flight into space a practical fact. But if we can add a little extra starting push to present power, perhaps we might not need to await new discoveries. Let us see. Consider the three-step rocket previously described (Bulletin No. 2 page 2). The total weight is 5120 tons. Of this 3840 is fuel and 640 tons the structure. The remaining 640 tons are the second rocket in the same proportions, carrying as its payload a final third rocket of 80 tons, of which 60 are fuel and only 20 tons represent the net payload of crew and supplies and structure. The proportion of total weight to final load is 256 to 1.

Each of the three steps is designed to add a velocity of $2\frac{1}{2}$ miles per second, making a total of the necessary $7\frac{1}{2}$ miles per second. The first step, the largest, is the only one which might be benefited by a starting push. Let us consider how much weight could be saved by giving a push of 1 mile per second before starting the rocket motor. Without the push, fuel must be carried for a velocity of $2\frac{1}{2}$ miles per second. With the push this is cut to $1\frac{1}{2}$ miles per second. The saving of fuel is almost two-thirds of the first rocket step, or 2468 tons. In addition there would be saved a proportion of the structure, 411 tons more. Total 2879 tons. The following table gives similar information for several such starting pushes in relation to the same rocket:

Starting push		tons saved	%	Final proportion of payload
3600 m.p.h. --	5280 ft./sec.	2879	56	112 to 1
1800	2640	1611	31	176 to 1
700	1000	594	$11\frac{1}{2}$	226 to 1
100	147	30	0.6	$254\frac{1}{2}$ to 1
none	none	none	none	256 to 1

From the above we can safely say that considerable effort could be justifiedly put upon the subject. The first outside aid to rocket flight is to start the voyage from as high an altitude as is practical. A mountainous site near a railroad would be ideal. From here we propose to obtain a speed of 1 mile per second without using the rocket motors.

We would prefer to obtain this speed in an almost vertical direction, but any angle down to 45° would be suitable. We have some data from German artillerymen on the firing of the "Paris Gun". This had a muzzle velocity of one mile per second and a range of 75 miles. They found that in rising twelve miles the speed dropped from 5000 ft./sec. to 3000 ft./sec. Of this loss of 2000 feet per second about 900 was calculated due to air resistance and 1100 due to the pull of gravity. The two factors almost balancing, the angle decided upon was approximately 45°.

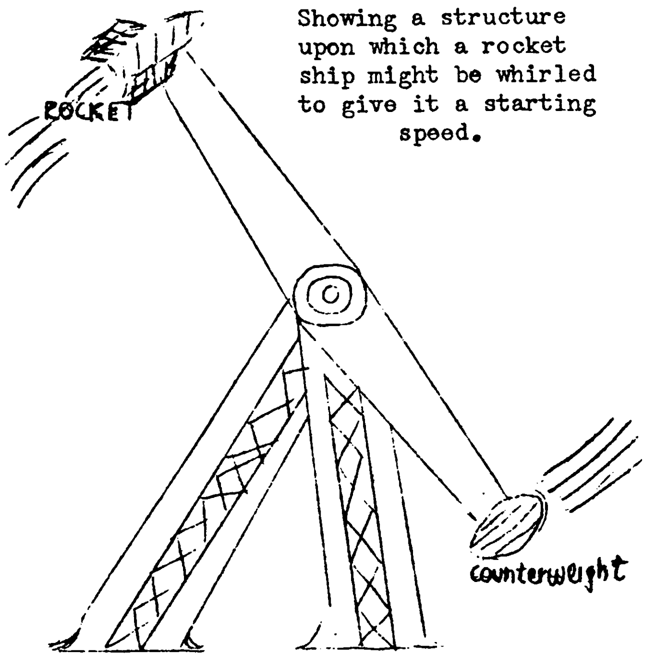
We might then form an initial conception of our starting apparatus as an incline suitably located. A track is laid and on it a huge cradle on wheels, carrying our space-ship. We might start the wheels turning with powerful gasoline motors. As the speed increases, rocket power could be applied. When full speed was attained, the ship's rockets would start. If the track were in the form of a gentle upward curve with very wide set wheels it would be possible to keep the ship from jumping the tracks. The friction involved would be enormous. I am afraid further power would be necessary.

One such suggestion is that the track be built up of a series of enormous electro-magnets and the cradle be pulled along in the same way as the rotor of an electric motor. It would be entirely practical to obtain enormous electric power for the few minutes it would be required, provided the start were made during the slack hours of the night. It would require almost half the production of the country to overcome friction and inertia at such speeds. I believe 1 mile a second impossible, although it is barely possible a speed of 700 miles per hour might be attained by these means. This design is important since some speed would of course be obtained by tried and tested methods.

Another suggestion is to build a huge cannon and force the ship out by compressed gases--not an explosion of course, but a gradually built up pressure, progressively increased. Power problems are easy here. But the cost of boring , or even casting such a huge affair would be enormous. It would, moreover, be so badly pitted and scarred by a few uses as to require replacement. But it has possibilities.

The heat of friction would be about the same as in the "Paris Gun". Should experiments now pending as to the resistance of the body to high acceleration prove disappointing, then such an idea as this might prove the only practical solution, since a very low rate could be used in the gun. If acceleration is 100 ft. per sec/sec. then a speed of 1000 feet per second would require a gun only 5000 feet in length. Still higher speeds would require very much longer guns--provided the acceleration remained the same.

But the fact is, 100 feet per second/second is too low. The human body can withstand much greater rates of acceleration. If it be increased to 200 ft. sec./sec. a speed of 3000 feet per second would require a barrel 22,500 feet in length. At 500 ft. sec./sec. (16 times gravity) the gun would be less than two miles in length for a speed of 3000 feet per second. This acceleration is I believe well within the strength of a human being. In fact more than twice this figure should prove possible. If an acceleration equal to 50 times gravity be used, a velocity of 1 mile per second could be obtained in a gun-barrel about three miles in length. This subject requires investigation, for it may prove the cheapest and easiest way of attaining such high velocities on earth prior to the use of the rocket-ship's own fuel.



Showing a structure upon which a rocket ship might be whirled to give it a starting speed.

We now come to an entirely different idea. Take advantage of centrifugal force, which tends to throw off an object in a direction tangential to the circle and at the same speed. This tendency is precise. The suggestion has been made by M. Esnault-Pelterrie to suspend a space-ship after the fashion of a car in a huge Ferris wheel. This wheel will whirl around at increasing speed and finally the car is released and flies off into space.

Let us imagine our space-ship as being about 100 feet in length. The wheel must be at least 500 feet in height and very strong. We wish to revolve the ship at 1 mile per second if it can be done. If such a wheel be properly balanced the power is not difficult to obtain. The speed can be gradually brought up. But we find that the final forces weighing on the occupants of the ship would be enormous. Each pound would weigh over a ton and a half! No man could support his own weight and live.

But the larger the wheel for the same speed of circumference, the less the centrifugal force. Imagine a wheel six miles high revolving 3 times per minute. It would attain at its periphery a speed of about 1 mile per second and yet the centrifugal force would be only 50 times gravity. Such a wheel would be at present impossible, but in order to attain one mile a second with safety such dimensions would have to be considered.

(There is omitted here a presentment of evidence tending to show the possibility of man's supporting a weight of 50 times gravity with reference to the experiment of Messrs. Norton and Schmidt reported in the Bulletin No. 9 page 2. It is hoped that these experiments, to be continued this winter, will result in corroboration of such a contention--which so far they indicate as correct.)

For these reasons I assume an acceleration of 50 times gravity, if gradually achieved, to be possible for a healthy human in good physical condition.

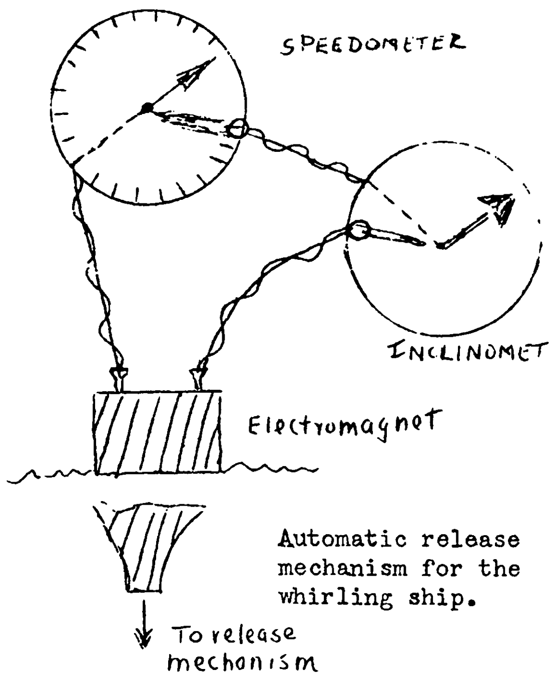
A structure about the size of the Empire State Building can be constructed. Beyond that we are in more visionary realms. Let us say that a wheel 1200 feet in height might be expensive, but in no way difficult from an engineering standpoint. Moreover a true wheel is not necessary. Two opposite spokes and a hub might be more to the point. At the extremity of one spoke is our 5000-ton vessel and at the other a counter-weight so that the rotation is balanced. The question as to whether a steel structure will stand the strain is merely academic. The strain must be kept down to the point where a human being can stand it--so obviously it will be well within the strength of steel. For such a structure, if acceleration is 50 times gravity the maximum velocity can be easily figured--it is 1000 feet per second. About 1/5 mile per second.

A wheel the height of the new Hudson River Bridge--say 3500 feet--would make possible a velocity at the end of its spokes of 1750 feet per second without increasing the centrifugal force beyond 50 times gravity. For this force, the following table is of interest:

Wheel diameter	launching speed	rev. per minute
1200 feet	1000 feet per second	16
3500 feet	1750 feet per second	10
4800 feet	2000 feet per second	8
$3\frac{1}{2}$ miles	4000 feet per second	4
6 miles	one mile per second	3

Imagine the inside of the rocket ship. In the control chamber lying on an elaborate couch of springs and mattresses is the pilot. He can see nothing of the outside world and feels nothing of the circular motion. What he feels is the pressure, always downwards to the floor of the ship, of his body--50 times normal. He weighs 7500 pounds and his powerful chest muscles can scarcely lift his ribs enough to obtain breath. To assist him the atmosphere here is almost pure oxygen.

It might even prove necessary to use the forced breathing apparatus recently designed for infantile paralysis patients. But with all possible aid he is half-suffocated. His heart throbs painfully. He cannot move hand or foot, but his finger tip could push a button if it be placed against it.



Automatic release mechanism for the whirling ship.

If the release of the ship from the wheel be by manual control, he must push the button at the exact moment, setting up an electric connection which will operate the release and permit the ship to fly off on its course and at the same time start the rocket motors.

The pilot's only guide as to the accurate moment is his instrument board. One dial indicates the velocity of the ship. When this pointer slowly climbs to the agreed speed, his eyes seek another dial which shows a miniature wheel revolving in the same relative manner as the huge wheel outside. On the face of this second dial is a red line at an angle of about 45 degrees. He must press the button when the miniature wheel indicator coincides with this line. The larger the wheel, the fewer revolutions per minute and the slower the movement of the hand--so that it would be easier to release accurately from a large wheel than from a small one. He must be accurate, for a slight mistake and his ship instead of plunging up into space would plunge down to the ground beneath and to almost certain destruction. What a momentous decision he must make--and under trying conditions!

Mechanical aid (see drawing on sheet 4) suggests itself. Let the pointer make electrical contact with the red line at every revolution of the inclinometer. When the ship's speed reaches the desired rate the pilot can now press the button instantly, for the contact will not be complete until this inclinometer is at the exact starting angle.

But the pilot need not even watch the speed indicator, for if the pointer on this instrument make connection with the part of the dial face which indicates the desired speed, then automatically a current is set up at the desired speed and the ship released when the angle is correct.

The pilot is then not needed at the start. He can try to keep alive, of course, The worst part of the pressure will last only a few seconds. The wheel starts slowly and only picks up speed gradually. As the pilot lies struggling for his breath, contact will be automatically made and all weight instantly cease for a second until the ship's rockets are in operation. He must be strapped in his couch, for it will rebound violently during the short interval.

Any starting push which can be given to a rocket would be perhaps small at present. But it is clear gain, whatever it amounts to. The margin between success and failure of a space voyage is small. In theory a rocket could today be built which would perform the work necessary to leave the attraction of the earth. If an extra 1000 miles per hour could be added success might result where otherwise failure would have ensued. If greater starting impulses than 1000 miles per hour prove possible--so much the better.

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STRATOSPHERE TEMPERATURE HIGH DECLARES SCIENTIST

Writing in Nature (London) G. M. B. Dobson declares that at a height of 50 kilometers (about 33 miles) the temperature will be about 400 degrees absolute or 127 degrees centigrade. This is considerably above the temperature of boiling water, and is in contradiction to the theories that the stratesphere is extremely cold.

Mr. Dobson reached his conclusions by a study of the amount of ozone in the air and its effect upon solar radiations. He concluded that the ozone probably absorbs all short wave solar radiations causing the temperature at the upper layers of the stratosphere to rise. He believes that this effect also accounts for the abnormal audibility of explosions at over 200 kilometers.

Mr. Dobson conclusions were presented in a talk at the Royal Institution in the Spring of 1931.

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OPEL HINTS OF NEW ROCKET EXPLOSIVE

In a recent visit to America, Fritz von Opel, German motor car builder and rocket experimenter, hinted that a new super-explosive for rockets was known to Germans and would make possible the building of successful rocket planes.

Von Opel, whose name has been linked with the General Motors Co., stated that the officials of the General Motors Co., were open minded about the question of rockets replacing motor cars and airplanes.

With the development of rockets in the next fifteen years, he expects to see the Atlantic spanned by passengers in three hours, and the globe circumnavigated in 24 hours. He stated that the new secret explosive gave rocket cars or planes 1,000 horsepower, though weighing only thirty pounds.

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IN THE CURRENT PERIODICALS

Among the articles on rockets in current periodicals is "Rockets to the Moon," by G. Edward Pendray, vice-president of the Society, in the October 1931 Elks Magazine.

Mr. Pendray's thesis is, that although there is nothing new to magazine readers in the idea of sending men through interstellar space by rocket, what is new is that men are doing more than merely talking about it.

Reviewing the practical activity of rocket experimenters in six natoons Mr. Pendray concludes, that "it seems safe to predict that we will see mail rockets winging from city to city with letters and fast express, and successful rocket ship flights being made in the next five or six years.

In the November issue of Nature Magazine, appears an article by David Lasser, president of the Society entitled "By Rocket to the Planets." Mr. Lasser describes the nature of an interplanetary journey, from the point of view of a possible passenger, and advances some views as to what man might find upon Mars or Venus.

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FUTURE PROGRAM OF THE SOCIETY

On the evening of November 13, Mr. Pendray, vice-president of the Society will sum up in a talk at the Museum of Natural History in New York the latest developments in rocketry, throughout the world.

On November 27, Mr. Nathan Schachner will speak on "The Existence of Man on other Planets," indicating the conditions that might favor or prohibit men from exploring our sister worlds.

On December 11, also at the Museum, the members of the Society will have the pleasure of hearing Dr. Alexander Klemin, head of the Guggenheim School of Aeronautics, New York University, discuss the Goddard Rocket plane, described in the previous issue of the Bulletin. This will be the first frank and full examination of a proposed rocket plane, by an eminent aeronautical expert.

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THE ROCKET AND THE NEXT WAR

(Abstract of a Report by David Lasser to the American Interplanetary Society at the meeting of October 22, 1931).

The problem of making war effectively, has become increasingly a question of destruction from a distance. There are three reasons--arising from the application of science to warfare--that make this true. The Great War proved, that mass conflicts of millions of men for a decision in the field of battle is unbelievably costly to the victor and to the defeated.

Secondly, the contributions of science to warfare, in the form of lethal gases, powerful explosives and disease spreading will make it necessary that they be utilized where they cannot spread death also among their senders.

Third, the increasing dependence of modern armies upon their source of supplies, and the necessity of harnessing all industry to the war machine, will make the destruction of enemy cities more effective than the demolition of armies.

Modern militarists admit these facts frankly, and in summation they agree that the strategy of future warfare will aim at the destruction of enemy cities, industrial centers, and railways rather than of the opposing armies.

The question of the future of military warfare, and therefore of civilized values depends, in the last analysis upon the ability of delivering death from a distance. And two weapons have been developed to make that possible--the air raid, and the long distance bombardment. If, in a future conflict, aircraft can invade enemy territory and drop their loads of death; and if projectiles carrying the latest creations of the laboratory can be shot in sufficient quantities into enemy centers of population, then in the next great war the warnings of our gloomiest prohpets may be realized.

It is my contention that an agent ideal to the use of the scientific militarist, for both the air raid and the long distance bombardment is now in the process of development; that its eventual perfection is but a matter of time; and its use in warfare is certain to occur. I refer to the rocket, The perfection of the rocket, in my opinion will give to future warfare the horror unknown in previous conflicts and will make possible destruction of nations, in a cool, passionless and scientific fashion.

To understand how the rocket will dominate future conflicts, consider the question of destruction by long range bombardment, one of the two agents of the scientific militarists.

Assume that two nations are at war and their armies have been rushed to the frontier. The strategy of the new warfare will call for the prevention of an enemy invasion, and simultaneously the destruction of the enemy centers by long range shells.

Consider what this means. Long range artillery, which previously had been used principally against opposing armies, at distances of 5 to 75 miles must now be adapted to shoot shells 200 to 500 miles. It will be necessary, furthermore, to hit the distant targets aimed at, and to hit them often enough to complete the desired destruction. For this novel task, in my opinion, present artillery is entirely unfit. And were the success of the long range bombardment to rest solely on artillery, one arm of the "destruction from a distance" program would surely fail. But luckily for the militarist, the rocket will supply him with the very principle that he needs.

The failure of artillery may perhaps be found in the record of the most ambitious attempt at the "strafing" of civilians- in the history of the German guns that bombarded Paris from the spring of 1918 to the close of the Great War. Firing shells 75 miles into the French metropolis, the Germans hoped to complete the panic of the Allies, under way through the success of their field armies. But even at the 75 mile range, the Paris Guns proved themselves as failures, and their weaknesses are inseparable from present artillery.

For the task of throwing a shell 75 miles through the air, it was necessary first of all to construct a monster gun, which with its auxiliary equipment weighed hundreds of tons. Great concrete foundations requiring days to construct, were necessary for the emplacement of each gun. The guns therefore, were by necessity in fixed positions, and lacking mobility they were subject to counterbombardment by the Allies. Despite the greatest secrecy in the placing of the guns, it was only 48 hours after the first shells fell on Paris, that the guns were located by French batteries. A hail of shells were sent against them, and one gun was destroyed and the crew of another was killed. For the entire period of activity of the guns, their fixed positions, exposing them to counterbombardment acted seriously to hamper their activity. A dozen shells a day was the most that a gun could fire with safety.

The necessity of a monstrously heavy ordnance for long range artillery cannot be avoided. The total impulse a shell must be given to it while it is in the muzzle. In a split second the shell must be accelerated by the explosion of the powder from rest to a speed of 60 times that of an express train. The fearful recoil, and the enormous stresses that the gun is subject to make any lessening of weight or equipment impossible.

Guns built for the longer ranges of 200 to 600 miles necessary for future warfare, would be such colossal and unwieldy monsters that their effective operation would be virtually impossible.

Aside from the lack of mobility and the dangers of the long range guns, they were found to be ineffective in accuracy and durability. The tremendous rush of highly compressed and heated gases caused such strains at each firing that the life of a gun was limited to 50 to 100 shots. It was then useless and had to be returned to the factories for reboring. Under such conditions accuracy was impossible, and a gun often overshot or undershot the 75 mile mark by at least five miles.

It is quite possible that even were long range guns constructed as mountains of steel, to withstand all the enormous strains of firing, and greatly increased speeds given to the shells they might fail to achieve the necessary ranges. For the rapid increase of air resistance against the shells created by the great velocities would cut the speed so quickly that the range would be limited. The added energy given a shell in the muzzle in order to increase its velocity might only serve to heat the shell by air resistance, and add not a mile to its range.

I have gone to this length in picturing the weaknesses of present artillery, in order to show more clearly that a rocket propelled shell is what is desired to make long distance bombardment effective. For the rocket, could, first, propel shells to distances impossible with artillery, and second could be shot in such numbers and with such rapidity as to constitute an avalanche of death from which there would be no escape.

The rocket carries its own fuel, and the motion of the rocket continues until the fuel has been exhausted and the momentum lost. If, to the rocket motor, there is attached a nose filled with high explosives, gas or anything that modern science can create, a self-propelling shell results, that should make possible the fondest dreams of the militarist.

Such projectiles would be gun and shell in one, and therefore no heavy ordnance would be necessary to shoot them. It would merely be necessary to give them a start, in a light gun, and they would carry themselves hundreds of miles, to strike with stunning force whatever they hit.

Batteries, shooting rocket shells into the heart of an enemy country could be built by the thousands, and fired with the rapidity of small calibre artillery.

The rocket, in fact, would travel through the air, in a manner just the opposite of that of an artillery shell, Whereas the long range artillery shell leaves the guns at its maximum speed, encountering at once the great resistance of the lower air levels; the rocket would leave the gun slowly, and only acquire speed as it shot upward into the high rarefied regions of the air, where the resistance was small. It would have its greatest speed, therefore, where the air was thinnest; whereas the artillery shell has its greatest speed where the air is densest, all factors thus naturally conspiring to limit the range of an artillery shell.

Shooting upward thirty to fifty miles above the earth in its passage, the rocket shell, would then drop with terrifying speed upon city or munition plant.

What would this mean in terms of an actual conflict? Scanning the map of Europe, we see that Paris could easily be shelled from the German border, and Berlin from the Rhine. London would be within range of both French and German shells; and little Switzerland, now a buffer state against the progress of opposing armies might find itself arched by a rain of Italian and French rocket shells, hurled into the heart of each other's territory.

Each nation could devastate the other in a rain of death, from which there could be no relief. All of the creative and destructive facilities of man could be destroyed without the necessity of a foot being set across an enemy border. Let us imagine the effect of the rocket upon America, in her isolated position. An enemy fleet might start upon the invasion of America equipped with rocket batteries that shoot shells 200 miles or more. This is possible since no heavy ordnance need be carried to shoot them. The fleet could anchor off our coast and reduce our forts to a mass of ruins. Our sixteen-inch guns, with maximum ranges of 30 miles would be toys compared to the naval rocket batteries. The invaders could hold off our own fleet quite leisurely by its superior range or destroy it. Assuming an equality of air forces, no opposition could deter the invasion.

Boston, New York, Philadelphia, Richmond, Washington, could be reduced by an enemy fleet resting in safety in the Atlantic; or our Pacific ports would fall without a serious counter blow being struck.

The rocket was actually used as a projectile during the Napoleonic wars, and considering the crude state of its development, it achieved surprising success. With untrained men, and small boats, Sir William Congreve a British enthusiast burned the French town of Boulogne with a hail of rocket shells, in 1807 and repeated on Copenhagen the next year, So alarmed did Napolean become at the success of this new weapon in the hands of his enemy, that he ordered his ordnance officers to learn the secret and build rockets at all cost.

The absurdly crude rockets of Congreve's day, faded in importance with the coming of rifled artillery; and the rocket as a projectile has not been used in warfare for nearly a century. But today with a new science of rocketry, created and backed by determined experimenters in a half dozen nations, the development of the rocket is proceeding with comparative swiftness.

Consider the second arm of the new military strategy, the air raid. Against present types of airplanes there is undoubtedly protection. Anti-aircraft guns are being perfected and becoming deadly in their accuracy; the airplane gives its own warning of approach, and it can be fought off by other planes. Desperate air battles on the frontiers of nations at war may mark future conflicts, with the invasion of its country as the price of failure of each force. But with evenly matched squadrons, it is quite possible that a defending army backed by anti-aircraft guns might be able to prevent an attack on its cities.

The air raid, for effectiveness must come with surprise, and must execute its work swiftly. Because the airplane must fly in the relatively lower levels of the air; because its approach can thus be detected, and its motors give warning; and because it is at the mercy of the elements, the airplane in my opinion will fail to effect the purpose of the future air raid.

What would be desired, is a plane that can sweep across enemy country so high that it cannot be detected, and so swiftly that little warning can be given of its coming. Such a plane propelled by the rocket promises to appear in the future. Because the rocket can operate in thin air, where the airplane is useless (and in fact the rocket develops its greatest power in the absence of air) rocket propelled planes can ascend to a thirty-mile altitude, or even higher, out of reach of opposing planes, and in fact, out of all visibility.

Flying at a speed of 3000 miles an hour in the upper layers, where there is no air resistance, rocket planes could flash over the enemy country, and with motors off swoop suddenly from the skies upon unsuspecting cities, and loosing its load of death, it could escape just as swiftly into the heavens.

One hour after war had been declared, an enemy fleet from across the ocean could bomb our coasts; and before we realized the stunning blow that had been dealt, the invaders could shoot away to return to their base.

Although this discussion of the use of the rocket may seem fanciful, it is based only upon what can be developed from the established principle. Experimental rockets have been flown in the last year, distances of three to five miles and to heights of two miles. Toy models, they developed considerable power and have encouraged experimenters throughout the world to continue to tame the giant that slumbers in the rocket.

Whether the man of the future, looking back to 1931 will wish that the rocket had never been invented, no one knows. It seems to me that the rocket is one of the creations of the human mind, that serves as a test of our right to inherit the earth. Its powers of good and evil are so equal and opposite.

Meetings of the New York members of the American Interplanetary Society are held twice each month at the American Museum of Natural History, 77th Street and Central Park West. Associate membership in the Society at $3.00 per year may be obtained by sending the first year's dues to the Secretary, Nathan Schachner, 113 West 42nd Street, New York. Information on the other classes of membership, active and special may be obtained by writing the Secretary.