A S T R O N A U T I C S

Official publication of the American Interplanetary Society, 147 West 86th Street, New York City

No. 26 New York May 1933

CONTENTS

The Flight of Experimental Rocket No. 2
(Report by G. Edward Pendray) - - - - - - - 1
Pictures of the Rocket Flight - - - - - - - - 11
Laurence E. Manning Becomes President - - - 12
Future Rocket Plans - - - - - - - - - - - - - 16

* * * * * *

## THE FLIGHT OF EXPERIMENTAL ROCKET NO. 2

By G. Edward Pendray
(Report delivered before the American Interplanetary Society, May 19, 1933)

Experimental Rocket No. 2 of the American Interplanetary Society was shot at 20 minutes past eleven o'clock, Sunday, May 14. It reached an altitude of approximately 250 feet after firing a trifle more than 2 seconds. At that height the flight was brought to an abrupt end by the bursting of the oxygen tank.

Despite this mishap, the experiment must be considered a success. It proved without doubt

the efficacy of the rocket motor developed by the Society, and gave us our first actual experience with the firing of a liquid fuel rocket. The accident proves the need of redesigning future rockets with a view to placing the oxygen tank well beyond the reach of the flame.

## Description of the Rocket

Rocket No. 2 was not a completely new rocket. Many of its parts, including the tanks and motor, were salvaged from the Society's first rocket, which performed successfully on the proving stand near Stockton, New Jersey, last November.*

The earlier rocket consisted essentially of two cylindrical aluminum alloy tanks, each five feet long and 1½ inches in diameter. These tanks carried the rocket fuels. They were fastened together at the upper end by tie-pieces, upon which the combustion chamber was held in such a way that the flame from the nozzle jetted down between the tanks. The distance between the fuel tanks in the old rocket was eight inches.

Due to a desire for lightness, the metal which held them in position was not very strong, with the result that the shocks and jars of transporting the rocket to the experimental site was sufficient to move the motor, tanks and fins out of proper alignment. Moreover, the original rocket was surmounted at the top by a split, pointed hood designed to hold the parachute. Due to the non-rigid construction, it was almost impossible to make this apparatus fit properly.

---

*See report in Astronautics, December, 1932

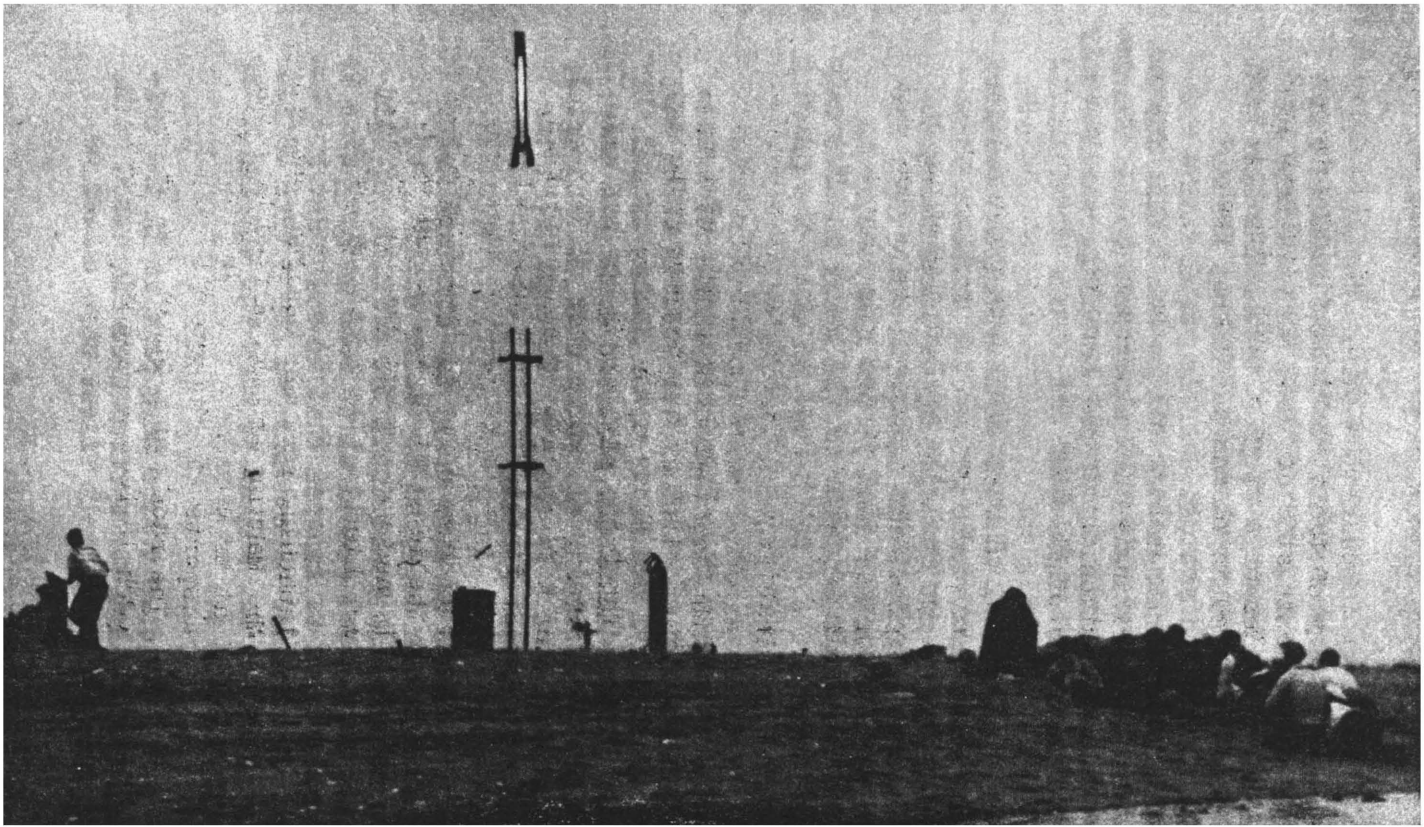
In constructing the second rocket we set out to overcome as many of these difficulties as possible. The major part of this construction work was done by Mr. Bernard Smith. Taking the old tanks, Mr. Smith removed the tie-pieces which originally carried the motor, and fastened this member between the upper ends with clamps and bands. The result was an exceedingly simple assembly, considerably more compact and rigid than the former arrangement.

The lack of structural strength exhibited by the first rocket was one of the problems which finally led to our decision against launching it. In the second rocket the motor and tanks were so firmly held together that it was unnecessary to fasten the tanks together at the lower end.The only device needed there was a band to carry the guiding fins.

Another step toward simplicity of construction was the adoption of air cooling doing away with the awkward and heavy water jacket around the motor. Movements of air past the motor was made possible by designing the motor case of thin metal, and leaving a hole in the top, through which air could rush during flight.

Since we were using the original motor (which had been designed for water cooling) we were somewhat in doubt about the efficacy of this step. It was not practical to weld cooling fins to the motor, but we assumed that it would not get too hot. Our earlier experience had shown that 20 seconds of firing had failed to warm the cooling water enough to boil it.

The same valves were used as in the original rocket, but the springs were dispensed with. By a simple device, both valves were turned on



THE ROCKET IN FLIGHT

An Unusual Photograph Taken by *Acme News Pictures, Inc.*

simultaneously by pulling a cord. This eliminated the uncertainty of the electrical firing method used in the tests at Stockton, but developed some new difficulties of a special kind which will have to be considered in planning the next rocket.

One other innovation of the second rocket is worth describing -- the guiding fins. At Mr. Smith's suggestion these were made of balsa wood, which, because of its lightness, seemed especially suited for this use. Thin metal fins, such as were used on the first rocket, lack rigidity and this difficulty cannot easily be overcome without adding to the weight. The balsa wood is inexpensive, easily worked, and can be coated with metallic paint for appearance and at least partial resistance to fire.

The inability of this material to withstand direct exposure to the rocket flame was borne out by the test. If used in the next rocket, wooden fins will have to be better protected.

## The Launching Layout

Rocket No. 2 was fired at Marine Park, Great Kills, Staten Island. Permission to use this very nearly ideal spot for our tests was obtained by our President, Mr. Laurence Manning, who enlisted the interest of Mr. Daniel De V. Harned. Mr. Harned was able to get the proper permits and was himself present at the test.

The launching rack was designed and constructed by Mr. Manning and Mr. Alfred H. Best. It was built at Mr. Manning's home in Great Kills, and later transported to the site of the experiment in sections. The rack consisted of two 2-inch pine poles, each 15 feet in length, fastened

together at the base by a four-by-four timber and other understructure, and at the upper end and middle by wooden shackles so arranged as to give the fins of the rocket clearance during passage. On location, the base of the rack was buried about two feet in the sand, and held in place by six guy ropes. The rocket could be inserted by springing the guide poles apart at the lower end. Before the flight the poles were soaped to reduce the friction of passage. A piece of sheet iron was fitted between the poles as a platform for the rocket.

The launching rack was inclined to about five degrees out to sea, the intention being to direct the flight definitely away from land. It had previously been learned, by calculation and actual test, that the rocket would float until recovered. To aid discovery in the water, the ends of the fins had been painted a bright red.

Twenty-five feet to the left of the rack the valveman's dugout was constructed, large enough to shelter three men - the lighter, his helper, and the valveman. Seventy feet to the rear of the rack a larger dugout, capable of holding about fifteen persons, was constructed. Here were stationed the command, the timer, and other observers. Another observation post was established 1,000 feet to the right of the rack, where a transit was set up to aid in calculating the height of the flight.

Other equipment needed for the experiment included a tank of nitrogen gas under pressure, and fifteen litres of liquid oxygen - both furnished without charge by Air Reduction Sales Company - and gasoline. The latter was a special mixture containing a small percentage of tetraethyl lead, prepared expressly for this test by the Ethyl Corporation.

## Preparing for the Flight

The rocket, launching rack and other materials were ferried to the site of the experiment in small boats. The preliminary construction work was done early in the morning, and by a little after nine o'clock the apparatus was ready for a ground test, considered necessary in order to make sure that the rocket was in proper working order.

The following persons were designated to take an active part in the experiment:

| | |
|---|---|
| Command | Mr. G. Edward Pendray |
| Valveman | Mr. Bernard Smith |
| Timer | Mr. Laurence E. Manning |
| Lighter | Mr. Alfred H. Best |
| Helper | Mr. Carl Ahrens |
| Transitman | Mr. Alfred Africano |

In order to avoid confusion during the actual experiment, these members went through a brief rehearsal of their various parts before the ground test. At ten o'clock, everything having been found in order, the rocket was charged with one pint of gasoline, and clamped firmly in the launching rack. For this test the balsa wood fins were removed.

When pressure was applied to the gasoline, it was discovered that a slight leak had developed in one of the valves. Before the pressure could be relieved, the valve was accidentally opened for a moment, and some of the gasoline escaped, leaving probably about a half pint for the test. In view of the lateness of the hour, it was decided to proceed with the test despite the leak, and to put on pressure only after the oxygen had been loaded into the rocket.

The oxygen was poured by Mr. Pendray through a specially made funnel. With this apparatus the oxygen filled in rapidly, and there was no such delay and discomfort as that experienced in the tests at Stockton. Two litres of oxygen were poured into the tank, approximately half of this evaporating during the pouring.

When the oxygen valve had been screwed down, Mr. Manning began to call time in half-minutes as Mr. Pendray and Mr. Smith put in the nitrogen for pressure. Mr. Smith then set the motor-case in place, inserted the valve-key and assembled the detachable lever which opened the tanks. He then took his place in the valveman's dugout.

At three minutes, Mr. Best ignited the wick below the motor, and as soon as he was safely under cover, Mr. Smith opened the valves.

The rocket performed well in the test, though the flame was, at first, unsteady and of a yellowish color. Toward the end of the test the color improved, possibly with the heating of the fuels, or it may be that the changing pressures in the fuel tanks brought about a better mixture.

The rocket fired only eight seconds in the test, the short period probably being due to the small supply of gasoline. Since the lift of this motor had been measured earlier, no lift-measuring apparatus was used in the test.

Examination showed that the firing had heated the motor considerably. It was too hot to touch, and sputtered when water was thrown against it. The force of the flame had torn a protecting layer of asbestos from the inner parts of the fuel tanks, and had thrown sand for fifteen or twenty feet from the base of the launching rack.

## The Rocket Flight

The test having proved satisfactory, the fins were fastened in place on the rocket, and it was refueled as rapidly as possible. About a pint and a half of gasoline was put into the tank, and two litres of oxygen, of which a little more than one litre remained at the end of the loading.

The gallery of observers had been augmented by members of the Society, representatives of the Bureau of Combustables of the New York Fire Department, and curiousity-seekers who had been attracted by our earlier activities on the island. Members of the Society were posted to warn small boats away from the side of the island toward which the rocket was aimed. Others helped to keep spectators at a safe distance. Two cameramen, one representing Acme News Pictures, and the other Universal Newsreel, had taken preliminary views, and now took up a position about 800 feet to the rear left to photograph the flight.

A stiff offshore breeze had sprung up, and though this interfered slightly with the pouring of the oxygen, it was considered advantageous in that most of us believed it would tend to blow the rocket away from shore, thus cooperating with the tilt of the launching rack in guiding the rocket out to sea.

The duties in connection with operating the rocket were performed by the same men, and in the same manner as during the ground test. Mr. Best applied the torch at a few seconds past the third minute. Everything seemed to be going off well until Mr. Smith attempted to pull the cord which opened the rocket's valves. At this point the detachable lever, probably loosened by the

wind, fell off the rocket. Mr. Smith courageously ran up to the rocket, where the fuse was burning merrily close to an oxygen tank that must by that time have been under pressure of nearly 300 pounds, and replaced the lever.

In his excitement, or perhaps because of. necessity, he then opened the valves before he had regained the shelter of his dugout. The photographs show that he was fully exposed at the time the rocket started. Fortunately there was no explosion at that point, and he was unharmed.

The rocket roared upward almost instantly, with a sound not unlike that of a large sky-rocket. As soon as it was clear of the launching rack, instead of heading out to sea, it began to veer into the wind, taking a course at right angles to that intended. It seems likely that this was due to the effect of the wind on the fins, blowing them out and thus causing the apparatus to steer into the breeze. It may also have been aided by the accidental striking of the fins upon the upper part of the launching rack. Such striking did occur, as subsequent examination showed.

During the flight, however, observers had little time to notice details. The rocket gathered speed rapidly, despite the shortness of the flight, reaching an estimated velocity of about 200 feet per second, at an altitude of about 250 feet. At that point the oxygen tank exploded with a loud pop.

The apparatus was almost instantly covered with the yellowish flame of burning gasoline. The guiding fins were thrown off. The tanks and motor continued the flight for several hundred feet, but fell over parallel with the ground. They finally dropped into the water about 400 feet offshore, and

were retrieved by two boys in a small boat. The fins dropped nearer to the land, and Mr. Smith rescued them by wading out into the water.

Hasty examination showed that the oxygen tank had ripped open near the middle, along a vertical line on the inside where it had been most exposed to the flame. The ripping was not due to the melting of the metal, but to a disrupting force from within, possibly aided by the softening affect of heat at that point where the bursting occurred. The fundamental cause, obviously, was the pressure rapidly built up in the oxygen tank by the extreme heat of the motor flame. This pressure was greater than the safety valve could relieve. The nozzle of the motor appeared scored and pitted, but it was not possible to tell how hot it had been. When brought out of the water it was cool.

A more complete analysis of the effects of the flight on the various parts of the rocket must await laboratory examination, now going on under the direction of the Experimental Committee of the Society.

* * * * * *

## PICTURES OF THE ROCKET FLIGHT

A number of excellent pictures of the test and flight were obtained by Acme News Pictures, Inc. of 220 E. 42nd Street, New York City. By special arrangement, the Society benefits by the sale of these pictures to newspapers, magazines and individuals, the money thus obtained going to help pay for future experiments. Members can buy them from Acme News Pictures, or from the Secretary of the Society, at $1 each.

## LAURENCE E. MANNING BECOMES PRESIDENT

Mr. Laurence E. Manning, one of the original members of the Society, was elected President by the Board of Directors, following the Annual Meeting held on Thursday, April 13, 1933 at the American Museum of Natural History in New York City. Other officers elected were:

| | |
|---|---|
| Vice President | C. P. Mason |
| Secretary & Treasurer | Dr. Samuel Lichtenstein |
| Librarian | Miss Lee Gregory |

Directors of the Society for the present year, elected by ballots cast by members present at the Annual Meeting and those voting by mail under the by-laws of the Society, follow:

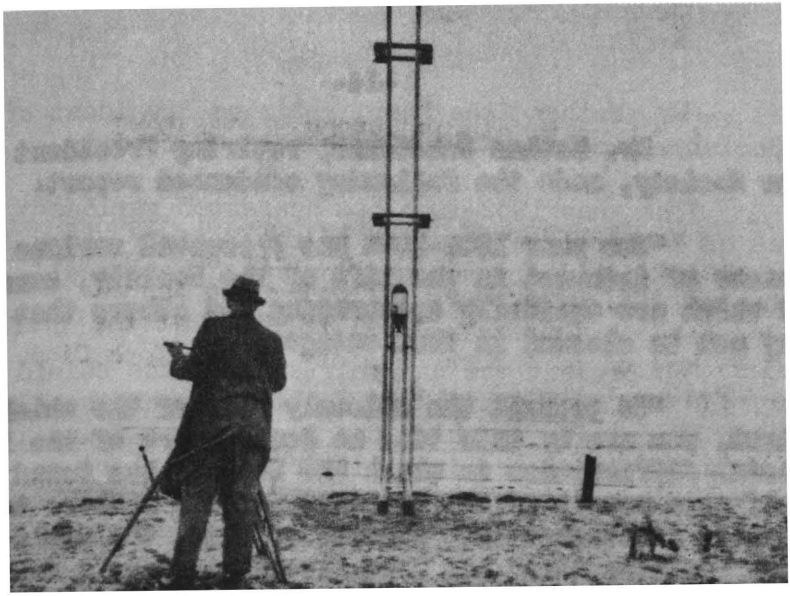
Dr. Samuel Lichtenstein — C. P. Mason
Laurence E. Manning — G. Edward Pendray
Nathan Schachner

The following were elected members of the Committee on Membership and Nominations:

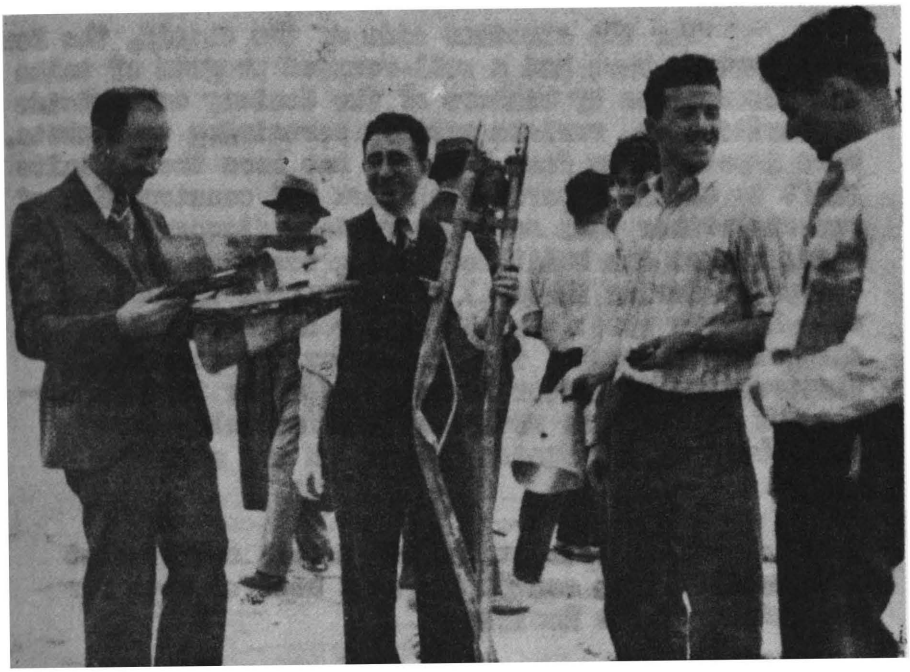
Dr. William Lemkin, Chairman
Miss Lee Gregory
Nathan Carver

Mr. G. Edward Pendray was continued as Chairman of the Experimental Committee, his associates being

Carl Ahrens
Alfred Africano
Nathan Carver
H. F. Pierce
Bernard Smith



THE ROCKET READY FOR LAUNCHING



THE ROCKET AFTER THE SHOT
(The Members of the Society Shown Are, left to right, Max Krauss, Nathan Schachner, Bernard Smith, Alfred Africano)

Mr. Nathan Schachner, retiring President of the Society, made the following condensed report:

"The year 1932-1933 has presented various phases of interest in the life of the Society, some of which are decidedly encouraging and others that may not be classed in that category.

"To present the unlovely side of the shield first, you are by this time no doubt aware of the financial difficulties in which the Society has found itself as a result of the inability of its members to support it adequately. Because of this, the publication "Astronautics" has been discontinued as a regular monthly printed magazine. This is a distinct blow, as the publication had more than proved its worth, but the Society intends sending out similar bulletins whenever there is anything of importance to say.

"For the smoother side of the shield, the New York members have had a well-rounded program of talks and discussions by members of the Society and outside authorities on various matters pertaining to rockets. More important by far, however, has been the definite shift to actual experimental work and construction of rockets rather than mere theoretical discussions. A model rocket was built and firing tests successfully conducted during the fall of 1932, from which valuable lessons were learned. The rocket was slightly changed as a result, though leaving the essential construction and motor intact, and after further successful tests, this rocket will be actually fired from Great Kills, Staten Island, in the next few weeks.

"It is this record of actual achievement with rockets that sounds the most hopeful note for the future of the Society."

## Treasurer's Report

Dr. Samuel Lichtenstein, Treasurer of the Society, made the following condensed report:

"The bookkeeping summary for the Society's fiscal year follows:

| | Receipts | Expenditures | Balance March 31 1933 |
|---|---|---|---|
| General Fund | $311.08 | $306.41 | $4.67 |
| Experimental Fund | 56.50 | 52.30 | 4.20 |
| Library Fund | 7.50 | | 7.50 |

"The assets of the Society appear under three headings:

"1. A general fund comprising receipts of membership dues. Against this are charged off the expenses of publishing 'Astronautics' and of administration business.

"2. An experimental fund made up of contributions and the receipts from the sale of news pictures. From this have come the moneys for the construction of the rocket.

"3. A library fund derived from the sale of back numbers of the society publications and other items in the library. This fund is to be devoted to purchasing additions to the library.

## FUTURE ROCKET PLANS

The excellent performance of the motor used in the flight of May 19th, and the success of the pressure-injection system of fuel feeding make it certain that these features of Rocket No. 2 will be used in the next rocket, which is now being designed, and which the Experimental Committee hopes will be ready for tests early next fall.

Rocket No. 3 will probably be constructed with both tanks upon a single axis, with the oxygen tank well in the rear, out of the path of the flame. At present it is planned to power it with a single motor, because of the new complexities attending the use of more than one combustion chamber. The third rocket will probably be larger than the others.

Suggestions will be welcomed. Address the chairman, G. Edward Pendray, 22 East 40th Street, New York City.

Associate Membership in the Society at $3 per year may be obtained by sending the first year's dues to the Secretary, Dr. Samuel Lichtenstein, 147 W. 86 St., New York. Information on other classes of membership may be obtained by writing the Secretary. Meetings of the Society are held monthly, except in summer, at the American Museum of Natural History, 77th St. and Central Park West, New York.