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Photos by Paramount Pictures and George James

Above— Joan Caulfield, Paramount Star, with Carroll Evans and George James at a press show held before the Yuma Rocket Mail Flight.

Below— Reaction Research Society Exhibit at the World Inventor's Exposition held at Los Angeles in July, 1947.

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EDITORIAL PROJECT GODDARD

By George James

Beginning in the Fall of 1947, the Reaction Research Society will open work on "Project Goddard," which name has been given to the Society's high altitude project.

The ultimate goal of this project is the development of a practical high altitude meteorological rocket, which will provide a simple and inexpensive means of recording weather conditions in the upper atmosphere.

Christened "Project Goddard" in remembrance of the pioneer rocket work done by Dr. Robert H. Goddard of the Smithsonian Institution, the first phase of Reaction Research Society work on this project will be devoted (Continued on page 16)

ELEMENTARY CONSIDERATIONS FOR

CONSTANT THRUST ROCKETS

By James Hummel

The liquid fuel rocket has two very important characteristics which make problems concerning it relatively simple. These are constant thrust and constantly decreasing mass. Let us use the following notation:

f	thrust
m_o	original mass
m	mass at time t
t	time in question
v	velocity at time t
ρ	rate of change of mass
g	acceleration due to gravity

In terms of these symbols, the above two characteristics of liquid fuel rockets may be expressed as follows:

$$f = \text{constant}$$

$$m = m_o - \rho t, \quad (1)$$

$$dm/dt = -\rho . \quad (2)$$

In a short interval of time, dt, the mass is practically constant and so we can say

$$f\,dt = m\,dv. \quad (3)$$

Substituting (2) into this, we get

$$-f\,dm = \rho\,m\,dv,$$

or

$$-\frac{dm}{m} = \frac{\rho}{f}\,dv.$$

Solving,

$$- \ln m = \frac{\rho v}{f} + C.$$

At $t = 0$, $v = 0$, and $m = m_o$. Then the constant of integration is

$$C = - \ln m_o$$

and from this,

$$v = \frac{f}{\rho} \ln \frac{m_o}{m} \tag{4}$$

From this we can derive the expression for the distance travelled at any given time since $v = ds/dt$.

$$dt \ln \frac{m_o}{m} = \frac{\rho}{f} ds$$

Again, using (2),

$$- (\ln m_o - \ln m) \, dm = \frac{\rho^2}{f} ds,$$

$$\ln m \, dm - \ln m_o \, dm = \frac{\rho^2}{f} ds.$$

Solving this differential equation, we find that

$$m \ln \frac{m}{m_o} - m = \frac{\rho^2}{f} ds + C.$$

Since $s = 0$ when $m = m_o$,

$$C = - m_o$$

and

$$s = \frac{f}{\rho^2} \left(m \ln \frac{m}{m_o} + m_o - m\right). \tag{5}$$

In deriving the above equations, the influence of gravity and air resistance were neglected. It can easily be shown that the influence of gravity on a vertically directed rocket will merely add a term to each of the above equations. It might be shown how gravitational force will effect equation (4).

The force on the rocket while travelling directly upward will be $f - mg$, so from (3) we can obtain,

$$\frac{f - mg}{m} \, dm = -\rho \, dv.$$

The solution of this differential equation is,

$$gm - f \ln m = \rho v + C$$

Under the assumed conditions the constant has the value

$$C = gm_0 - f \ln m_0.$$

This, in connection with (1), gives

$$v = \frac{f}{\rho} \ln \frac{m_0}{m} - gt \qquad (6)$$

In the same way, we can show that equation (5) must be modified to

$$s = \frac{f}{\rho^2} \left(m \ \ln \frac{m}{m_0} + m_0 - m\right) - \tfrac{1}{2}gt^2 \qquad (7)$$

The questions of units might be brought up here. Although (6) and (7) are perfectly correct (neglecting air resistance), the units must be chosen correctly if the results are to be true. In the english system, if velocity is to be found in feet per second, and distance in feet, mass must be expressed as pounds, ρ in terms of pounds per second, and the force in poundals.

Force in poundals equals 32.17 times the force in pounds.

Actually, a much better system of units would be the metric system. If mks units were used throughout all rocket work, the computations would be much simplified. In the mks system, distances are expressed as meters, time is in seconds, mass is in kilograms, and force is in newtons. To those unfamiliar with the mks system, it might be explained that a newton is equal to 10^5 dynes. Force in newtons may be found by multiplying the force in kilograms by g in the mks system. The value of g in this system is 9.8 meters per second.

It must be emphasized that equations (4) and (5) are true only in the absence of air resistance and any other external forces, while equations (6) and (7) are true only in the absence of any air resistance and in a constant gravitational field. Equations (5) and (6) would be true close to the surface of an airless planet such as the moon. In free space where there is no air resistance we can write an expression for velocity and distance traveled within an interval in which gravitational attraction does not change much.

$$\Delta \vec{V} = \Delta \vec{V}_r + \vec{G}\,\Delta t \qquad (8)$$

$$\Delta \vec{S} = \Delta \vec{S}_r + \tfrac{1}{2}\vec{G}\,(\Delta t)^2 \qquad (9)$$

Where $\vec{S}_r$ and $\vec{V}_r$ are the vector quantities found from equations (4) and (5) and $\vec{G}$ is the gravitational attraction vector.

The equations derived in this article are much more interesting from a theoretical standpoint than from a practical viewpoint. In later articles I will attempt to show how (8) and (9) may be employed and also how (6) and (7) would be changed in a resisting medium. These are questions of more immediate application.

INDUSTRIAL & INVENTORS EXPOSITIONS

The Reaction Research Society made its most important public appearances to date this summer with two exhibits, one at the World Inventors Exposition, held from July 11 to 27, and the other at the Fourth Annual Southern California Industrial Exposition, held from August 16 to 27. Both of these expositions were presented at the Pan-Pacific Auditorium in Los Angeles.

The exhibit of the RRS at the World Inventors Exposition had on display three rockets, made by Society researchers, that graphically showed its advance in the previous year.

First was the propellant chamber of the "R6-6," a mercury switch landing device test rocket, which was fired on June 28, 1946. This rocket was approximately four feet long, and was made of aluminum tubing. When fired, it rose to a height of 750 feet.

Second was the "Submiler" rocket, approximately seven feet long, which was fired on February 23, 1947, at the Society's testing ground near Palmdale, California. This rocket trevelled a distance of 2100 feet from the firing point.

Third in this series was the "Miler V," a fifteen-foot-long mail rocket, displayed on the rack from which its four predecessors were fired. All five of these rockets have been of almost identical design.

"Miler I" was fired on March 23, 1947. "Miler II" was fired June 1, 1947. Both of these rockets were fired at Palmdale. "Miler III" and "Miler IV" were fired from Winterhaven, California, to Yuma, Arizona, on June 28, 1947, each rocket carrying a load of 350 specially stamped and cacheted envelopes. Because of excessive temperature to which it had been exposed, the

"Miler III" exploded and its cargo was lost, but the "Miler IV" successfully completed its flight. These rockets have all had stainless steel propellant chambers and aluminum mail heads. Samples of stamps and flown covers were shown in the exhibit.

Also on display was a solid-liquid engine test stand, by which the thrust generated by this type of engine can be determined. Mounted on it was a solid-liquid engine, capable of generating 100 pounds of thrust, which has had several successful test runs.

The pictures, magazines, and diagrams which were shown at the Society exhibit were from the Society files and from the collections of various members. In addition, motion pictures were shown which demonstrated various phases of the Society's work.

At the Industrial Exposition, the emphasis was placed on the possible commercial use of rockets for meteorological and mail purposes. In addition to a twelve-foot, full-scale model of the proposed "Project Goddard" rocket, and the "Submiler," the parachute test rocket "Slim Jim" was placed on display.

Also exhibited was a "mock-up" of a possible meteorological rocket, showing the design for such a rocket and its booster unit. A test stand for testing small jet engines was also shown.

On the backdrop was a strip diagram showing the path of a mail rocket from Los Angeles to San Francisco. The letters "R R S," made from large photographs of jet and rocket planes, were part of the backdrop at both this and the Inventors Exposition.

Volunteer society members staffed the exhibits every evening and most afternoons, and many interested visitors to the Expositions inquired about the Society and its work.

NAVY GUIDED MISSLES

Reaction Research Society members who visited the World Inventors Exposition in July, or the Industrial Exposition in August (at both of which the Society was represented) had an opportunity of examining the latest non-secret Navy developments in the field of guided missles.

Presented by the United States Naval Air Missle Test Center at Point Mugu, California, the exhibit consisted of six rocket- or jet-propelled missles and one target drone powered by an internal combustion engine. Photographs and color transparancies of the missles described them and illustrated their operation.

NAVY KUW-1 (LOON)

The Navy KUW-1, Code Name (LOON), is a modified copy of the German V-1. It its present form it carries almost one-half of its total weight as bomb load, making it one of the most efficient long range weapons of its type now available for use.

The Germans used this type of weapon to good advantage during World War II. The German "Buzz-Bomb" was flight tested as early as the Spring of 1942 and will be remembered as one of the first and most terrifying of the German "terror weapons."

Its maximum speed is above 425 mph and it has a range of about 150 miles. Through a combination of radar and radio control it is possible to hit within an area one-half mile square and 100 miles distant from the launching point.

Possible uses of this type guided missle are:

(a) Attacks by night or day against enemy area targets. LOON can be launched from its carrier many miles from its target, and by using automatic controls or radio control can be guided to a target.

(b) Attacks by night or day against enemy shipping targets. For this operation the LOON could be operated from shore installations in defensive operations and from ship-board in offensive operations.

The dimensions of the LOON are as follows: 27feet in length; wingspread of 18 feet; and a maximum body diameter of 18 inches. It is painted yellow, red, and black for visibility.

NAVY KUD-1 (GARGOYLE)

Gargoyle is a radio controlled, powered, gliding bomb. It is launched from a mother plane and guided to its target by visual observation. It was designed for use against moving targets such as ships and tanks.

Gargoyle is powered by a standard JATO unit that develops a thousand pound thrust for eight seconds. Thrust is not applied until Gargoyle is well clear of the mother ship. This thrust will cause it to attain a speed approaching that of sound. It is controlled for the remainder of its flight by the pilot of the mother plane following well behind it until it makes its hit. It produces the same psychological effect as the Baka or Kamikaze, and affords the launching plane a large measure of protection through diversion of anti-aircraft fire to the missle itself.

X-4 GERMAN ANTIAIRCRAFT MISSLE

The X-4 German antiaircraft missle was designed as a defense against allied bomber formations. It was launched from the Messerschmidt 109 or 262 aircraft.

This missle would have been effective as a countermeasure against the Allied bombing raids had it reached the production stage. Pilots would have found it extremely difficult to combat because of its high speed, approximating 500 miles per hour, and its relatively small size.

At the time V-E day was announced, the X-4 was a completely developed missle and just short of being set up for production.

One of the most interesting facts regarding the X-4 was the manner in which it was controlled. The control signals were sent from the parent aircraft through wire which wound from bobbins on the wings of the missle and the plane. The total length of the wire was slightly over 3½ miles. By using direct wire control the possibility of "jamming" was eliminated. "Jamming" is a process whereby conflicting signals are sent by the enemy to disrupt radio communications or radio control.

Although it might not have been too serious a consideration, the Germans were concerned about the difficulty of having miles of fine wire scattered over the countryside in the event that the X-4 was put into general use.

The X-4 was powered by an acid-aniline rocket motor and was capable of 20 seconds of powered flight. It is 6 feet, 5 inches in length, has a maximum body diameter of 9 inches, and a horizontal wingspread of 32 inches.

NAVY KUN-2 (LITTLE JOE)

Little Joe is a short range radio controlled, flare sighted, ship-to-air, anti-aircraft missle carrying a bomb of sufficient size to destroy any aircraft produced today. It is normally launched from a shipboard catapult with the aid of four standard rockets. It is a Canard type airframe (main supporting surface in the rear, elevators in front) with a cruciform wing and bow. It is powered by JATO solid fuel rocket, which contributes a thousand pound thrust for eight seconds.

Little Joe was originally conceived to combat the threat of the Japanese man - carrying Baka bomb* during the latter stages of the war. Due to the abrupt ending of the war Little Joe was never tactically used. However, tests are going ahead and the information gained therefrom is being applied to Little Joe's successors.

NAVY NU2N-1 (GORGON)

Gorgon is a winged, rocket-propelled, air-to-air missle that is directed to its target by radio control link with the mother plane using tracking information obtained by a telemetering set carried in the missle.

It is of Canard design and propelled by an acid-analine liquid rocket motor. The warhead is of sufficient size, when detonated either by contact or remote control, to render helpless a bomber or any number of bombers in formation. Gorgon today is serving a very useful purpose in the capacity of a test vehicle. It is utilized as a test tube for many of the component parts which go into more complex "Buck Rogers" weapons of the airborne Navy.

The first successful flight of the Gorgon was made in March 1945 and had the distinction of being the first successful flight of a jet propelled radio controlled pilotless aircraft in this country.

Gorgon is 16 feet long, and has a wingspread of 11 feet.

NAVY KDD-1 (KATY-DID)

The KDD is an all metal mid-wing radio controlled pilotless aircraft. It is powered by an 8-inch pulse jet engine capable of developing 115 pounds thrust at sea level. It will attain a speed of 230 miles per hour.

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* See Cover of ASTRO-JET #12, December 1945.

Both the aircraft and the engine are manufactured by the McDonnell Aircraft Corporation, St. Louis, Missouri. One of the unique features of the KDD is that the empennage section consists of two stabilizers joined at the tail to form a "V," and two movable surfaces called ruddevators. This term is derived from a combination of the words rudder and elevator. The ruddevators perform both functions of lateral and vertical control by moving co-directionally, up and down for elevator control and left and right for rudder control.

The KDD is now undergoing extensive tests at the Naval Air Missle Test Center, Point Mugu, and is proving invaluable inasmuch as the information being gathered is applicable to future jet propelled missles. The ultimate use of the KDD will be for anti-aircraft gunnery practice and gunnery training for pilots and air-crewmen.

The KDD is designed to be dropped from a "mother" aircraft or launched by catapult from the ground. The landing is accomplished by means of a parachute, the operation of which is controlled by the central pilot in the "mother" plane or from the ground.

KDR-1 (TARGET DRONE)

The KDR-1 target drone is manufactured by the Radioplane Corporation, Van Nuys, California. It is powered with a Kiekhafer 35 h.p. engine.

This radio controlled target drone is a high speed, high performance target and is suitable for air-to-air and ground-to-air gunnery.

Performance data: High speed level flight, 190 mph. Can perform any maneuver that a conventional fighter type aircraft can. It is recovered at the termination of its flight by a standard 24-foot parachute actuated by remote radio control. It can be remotely controlled from a ground control or a parent aircraft.

RRS RESEARCH PROJECT NO 14

IGNITION MECHANISMS
CONTROL BOX NO. 3

By J. Robert Seth

As the rockets of the Reaction Research Society became larger and more powerful, it became quite evident that a much safer and efficient means of rocket ignition was needed. A solution of this problem was attempted during the latter part of May, 1947, by Dudley Neff and myself.

Our first major operation of the project was to list all of the devices and units that should be controlled by such a control box. We finally decided on the following units:

1. Five minute before launching warning flare. 2. One minute before launching warning flare. 3. Ten seconds before launching warning flare. 4. Rocket tracking smoke flares. 5. Propellant. 6. All clear signal. 7. Signal or warning horns.

We also planned for a buzzer and light to be installed in the box that could be controlled from the photographic pit. It would be used for signalling between photographers and ignitors. Ignitors could signal photographers with signal horns.

To insure the safety of the ignitors who must connect the fuse wires of the ignition system we planned two sets of safety switches.

The first safety switch system was composed of two switches. We called them arming switches. One arms the warning switches and the other arms the propellant and all clear switches. The tracking smoke was not wired through the arming switches as we planned to use this circuit to control an automatic camera unit.

The second safety device consists of a jack-plug that will cut off all circuits except the warning horns and signal buzzer. This jack-plug is to be kept attached to the ignitor by a short length of chain. Any time the ignitor leaves the control pit, the control switch circuits are dead. We decided to power the igniting system by tapping the power or battery of an automobile.

For testing purposes we installed eight signal lights. One signal light for each warning switch (3), propellant switch, tracking smoke flare switch, and all clear switch. We also installed a signal light on the photographers' signal system and a signal light to show when any current passed the jack-plug.

We decided to install two trigger systems. One was installed in the form of a push button on the control panel. The other was a trigger installed on a length of cable that would enable the ignitor to move about in the ignition pit for better vision and still ignite the desired unit.

With all of the units located on the prospective print we started making the wiring diagram. We ended with twenty-seven units in the box: 8 switches, 8 signal lights, 4 push buttons, 1 jack-plug, 1 jack-plug receptacle, 1 pistol grip trigger, 1 buzzer, 1 26-contact cannon plug, 1 control panel, 1 mounting panel, and 144 wires to connect units in sequence and to cannon plug.

The second operation was to build the box. This phase of the project was started forty-two hours before the starting time of the testing of June 1, 1947. It was completed just a few minutes before the starting time. There was a total of 83 man-hours of work involved in the construction of the control box. Parts for the box were obtained from aircraft war surplus.

The control box was first tried at the testing of June 1. A total (Continued on page 18)

LONG RANGE MAIL ROCKETS

Although short range rocket mail is practical for certain special purposes, the main future use of rocket mail will be in long range flights.

With present knowledge it would be possible to design and build a mail rocket with a range of 500 miles. This rocket would have sufficient range to carry mail from Los Angeles to San Francisco. Except for its slightly larger size and short wings the mail rocket would resemble a V-2. The short wings are necessary to give the rocket sufficient range. During the war, the Germans found that stubby, swept-back wings would extend the range of V-2s from 200 to 350 miles.

With present electronic knowledge it would be possible to develop a guiding system for the rocket that would enable it to be kept under control from the ground during the entire flight and also during take-off and landing.

Since the rocket, like an airplane, would be used over and over, the main cost of firing would be the propellant. This improved V-2 would probably require about one and one-half times the propellant of a present V-2 or about fifteen tons (30,000 pounds).

Assuming fifty cents a pound for the propellants, oxygen and alcohol (the cost would probably be less for such large quantities), the propellant would cost a total of $15,000. The rocket would be able to carry a ton of mail (2,000 pounds). That means to merely pay for the propellant, mail would cost roughly fifty cents an ounce (most letters weigh one-half ounce). Including special delivery service at the end of the flight, and rocket maintenance cost, the charge for sending a one-ounce letter would be about $1.00.

For $1.00 you would be able to mail a one-ounce letter from Los Angeles at 10:00 a. m., at 10:10 a.m. the rocket would land at San Francisco and by 10:45 a. m. the special delivery service would have the letter delivered — a mere 45 minutes after having been mailed.

Based on the number of telegrams sent daily between San Francisco and Los Angeles, it would be financially possible to send one rocket each way daily. For most people rocket mail would be more satisfactory than telegrams, because of the greater length of a letter for the same cost as a several-word telegram.

The San Francisco-Los Angeles rocket is about the largest possible in the immediate future. At the present time it appears that very long range mail rockets will have to await the development of controlled atomic energy.

The advantages of rocket mail would be:

1. Allows exceptionally fast mail service.
2. Rocket mail is more economical and just as fast as a telegram, including processing time.
3. The design of a 500-mile mail rocket is now technically possible.

EDITORIAL: PROJECT GODDARD

(Continued from page 1) to the development of a satisfactory parachute mechanism, a problem which has plagued rocket experimenters for years.

Phase Two of this experimentation will be devoted to the development of a satisfactory liquid-fuel engine. Other phases will be announced as research is begun on them.

Concurrently with the opening of "Project Goddard," the Reaction Research Society will begin an extensive public relations program to acquaint the public with the Society's work.

A HISTORY OF ROCKET MAIL

Man has always tried to get faster mail delivery. In their day, pony express and later the train were the fastest forms of mail transportation. Now the airplane is the fastest form of mail service. Rocket mail would be exceptionally fast. Wartime V-2's travelled 200 miles in five minutes. Theoretically a rocket could cross the Atlantic Ocean in thirty minutes.

Although no long range mail flights have been held, the possibilities of rocket mail have been demonstrated by the several short range flights held in the past.

About twenty years ago steamers used large signal rockets to send mail to some South Sea islands because the heavy surf prevented the ships from approaching the islands.

From 1930 to 1933, an Austrian by the name of Schmieling cunducted numerous rocket mail flights between two towns in Austria. These towns were a half-day apart by road but only a few minutes apart by rocket. The largest mail load carried by one of his rockets was 288 letters. His research was stopped in 1933 by the Austrian government.

About the same time a German, Gerhard Zucker, was also conducting rocket mail experiments. His flights were not as successful as Schmiellings, for many of his rockets exploded. He tried several flights in England, but because of the poor qualities of his rockets he was requested by the authorities to desist.

A rocket mail flight was held in Holland in 1935. A flight was also held in India, but very little is known about either of these.

In 1935 the first rocket mail flight was held in the United States, at Greenwood Lake, New

Jersey. This mail flight was also the first to attempt the use of a liquid-propellant rocket engine instead of the usual solid-propellant engine. Due to failure of the rocket's wings on takeoff, this flight was not very successful.

In 1936 a flight was held between McAllen, Texas, across the Rio Grande River to Reynosa, Mexico. About 1000 covers were carried in three rockets an average distance of 2000 feet. This flight was unique in that after the rockets from McAllen had landed, an equal number of rockets were fired from Reynosa to McAllen.

The only government-sponsored rocket mail flight was held in 1939 in Cuba. The rockets must have been fairly poor for the results of the flight were never revealed in detail.

The most recent European flights were held in Holland and Belgium in 1946. Details are as yet lacking on these flights.

The Reaction Research Society mail rockets, fired on June 28, 1947, while not traveling the greatest distance, did carry the largest number of letters per rocket of any mail flight held up to the time of this writing.

RRS RESEARCH PROJECT NO. 14

(Continued from page 14) of four rockets and one restricted rocket charge were fired without error.

At the Yuma mail rocket flight held on June 28, 1947, there was a misfire of both propellant charges. This was not due to any failure of the control system but due to the fact that the smoke charges blew the propellant fuse loose, breaking the circuit.

This control box is the first of a series of new devices which will greatly aid in the conducting of RRS research.

BOOK & MAGAZINE REVIEWS

By Arthur Louis Joquel II

BALLISTICS OF THE FUTURE (With Special Reference to the Dynamical and Physical Theory of the Rocket Weapons), by Ir* Dr J. M. J. Kooy and Prof. Dr Ir* J. W. H. Uytenbogaart. Published by the Technical Publishing Company H. Stam, Haarlem, Holland. Price, 30 guilders (approximately $12.00).

"In comparison with the overwhelming literature in other branches of knowledge, the world of books contains few volumes dealing specially with ballistic science," states the preface to this book. But it seems that this one volume has been designed to fill the discrepance by itself.

Practically the entire field of rocket ballistics is covered by this technical work, which was published in the English language "in view of the great interest shown in these problems in America and England."

It will be possible here only to summarize the chapter headings of the first sections, to give an idea of the contents of the book. Chapter I, Vector Calculus; Chapter II, Vector Calculus applied to general dynamics; Chapter III, Dynamics of the Solid; Chapter IV, On the equations of a connected system; Chapter V, Numerical integration; Chapter VI, The projectile as material point; Chapter VII, General theory of a gravitating spinning top; Chapter VIII, The projectile as a solid; and Chapter IX, Terrestrial Dynamics of the rocket.

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* "Ir" is in the Netherlands the title, protected by law, of the "Ingenieur" of the Technical University of Delft.

Chapters X, "The German robot plane V 1 (Vergeltung Eins)," and Chapter XI, "The German giant rocket V 2 (Vergeltung Zwei)," will be more intelligible to the reader whose knowledge of higher mathematics is small or nil. Here are detailed, diagrammed descriptions of the V 1 and V 2, together with many previously unpublished photographs of these projectiles both on the ground and in flight, and of the damage which they caused.

A short historical sketch of rockets is given in Chapter XI. "Extra-Terrestrial Dynamics of the rocket" is the title of Chapter XII, which includes several sections on methods of calculating orbits for a moon rocket.

The book has a detailed index and contains a large number of maps, diagrams, and other data. It is an outstanding work designed to fill a definite need in this field.

DAWN OF THE SPACE AGE, by Harry Harper. Published by Sampson Low, Marston & Co., Ltd., 43, Ludgate Hill, London, W. C. 4. Price, 8/6 (approximately $1.80).

A welcome arrival in the form of a "layman's book" on rockets is "Dawn of the Space Age," by Harry Harper, a member of the Combined British Astronautical Societies. Here are no pages of involved formulas, but a vivid, clear picture of what rocketry actually is, written in plain but accurate terms.

In short chapters and readable paragraphs, the author covers the present field of rocketry in the book's three sections, which are titled "The Story of the Rocket, and the Coming of Atomic Power," "Objectives of Space-Flight—the Moon, Mars, and Venus," and "Design and Construction of Vessels for the Navigation of Space."

The first section, after an optimistic look at atomic power as a motivating force for future rockets and a stinging "Word for the Skeptics," outlines the research and practical use of rockets from early Chinese times to the V-2, including mail, signal, and transportation rockets.*

Conditions which prevail on the Moon, Venus, and Mars are discussed in the second section, which also devotes several chapters to the creation of "artificial islands" in space, perpetually circling the Earth at a fixed distance.

The third section describes the plans prepared by the British Astronautical Societies for the construction of a 1,000-ton rocket (the V-2 weighs about 12 tons) for a flight to the Moon. Such problems as fuel, instruments, supplies, space-suits, and the actual launching of such a rocket are described, and the book closes with an optimistic hope for the future of rocketry.

Kenneth W. Gatland, Co-Founder of the Combined British Astronautical Societies, has contributed a stimulating Preface to the book. A dozen illustrations, both drawings and photographs, add to the interest of the text.

THE GRAVITATIONAL REACTION MOTOR, by Arnold G Guthrie. Published by the Author. Price 25¢.

Mr. Guthrie believes that "Chemical fuels in rockets for tomorrow's spaceships are obsolete today." Instead of spaceships forcing themselves away from planets against the pull of gravity, Mr. Guthrie forsees the control of gravity, both in interplanetary and atmospheric travel.

To this end, he has designed a "gravitational electronic reaction motor," which he describes to some extent in this pamphlet. While it appears that this engine has not yet been constructed, Mr. Guthrie states that his motor is

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* One error should be noted here. On Page 44 the figures 15,000 feet and 33,000 feet should read 1,500 feet and 3,300 feet respectively.

"the ONLY possibility for achieving...control" (of gravity) and that "The date of interplanetary travel will be the same date that my gravitational electronic reaction motor will be utilized for that purpose."

A CRITICAL REVIEW OF GERMAN LONG-RANGE ROCKET DEVELOPMENT, by W. G. A. Perring, F.R.Ae.S. In THE JOURNAL OF THE ROYAL AERONAUTICAL SOCIETY, July, 1946. (Also published separately in the form of proof sheets of the article.)

This article begins with a short survey of German rocket research, and then goes into a detailed description of the V 2 (A 4) rocket, profusely diagrammed and illustrated. Performance figures and charts are given, and Mr. Perring indulges himself in speculations as to the performance of the winged, piloted V-2's which were proposed by the Germans just before the end of the war.

Also mentioned in passing are other German rocket resigns, including the "Wasserfell" and "Enzian." The Me.163, which was propelled by a rocket unit, and the "Natter" are also discussed and pictured.

As this article was originally presented as a paper before a meeting of the Royal Aeronautical Society, an abstract of the comments and questions of the society members present on that occasion is presented at the end of the article, forming an interesting appendix.

THE PHYSICS OF ROCKETS, by Howard S Seifert, Mark M Mills and Martin Summerfield. In AMERICAN JOURNAL OF PHYSICS, January-February, March -April, and May-June, 1947.

This comprehensive article begins with a discussion of the principles of rocket propulsion, including a section on the dynamics of rocket jets. It then takes up solid-propellant fuels, their application, manner of operation, equations of chamber pressure, and the problems and design of restricted-burning and unrestricted burning rockets.

The second installment turns to liquid-propellant fuels, with sections on their typical characteristics, the fundamentals of liquid-propellant rocket motors and the application of such motors. A very short mention is made of missles and sounding rockets.

In the third installment, the problem of sounding rockets and escape from the earth is dealt with at considerable length. After giving the history of high-altitude rockets, the general equations of motion of a rocket are discussed, which leads into the considerations of flight into space. Multiple-step rockets are diagrammed and described, and tables are given of escape velocities and step-rocket payloads.

The final section of the article deals with the possibilities and problems of rockets utilizing nuclear energy. The three installments are profusely illustrated with photographs and diagrams, and should be of value to both the theoretical and practical rocket experimenter.

EXPLORATION OF THE UPPER ATMOSPHERE BY MEANS OF ROCKETS, by H. E. Newell, Jr. In THE SCIENTIFIC MONTHLY, June, 1947.

This article deals mainly with a description of various instruments, such as spectrographs, Geiger counters, ion density measurers, and others, which have been sent aloft in V-2 rockets at White Sands, New Mexico, the difficulties of their recovery after the flight, and information obtained from them.

Several diagrams and photographs of records thus obtained are included in the article, which also discusses the telemetering equipment used for transmitting information to the observers.

BULLETIN OF THE BRITISH INTERPLANETARY SOCIETY
Volume 2, Number 2; February, 1947
Includes, among other articles, The Initial Acceleration of a Rocket and Le Moteur Nucleare.

BULLETIN OF THE BRITISH INTERPLANETARY SOCIETY
Volume 2, Number 3; April, 1947
This issue includes: Some Energy Considerations and interesting Questions and Answers.

BULLETIN OF THE BRITISH INTERPLANETARY SOCIETY
Volume 2, Number 4; May, 1947
A Universal Escape-Velocity Mass-Ratio Chart and The Problem of Atomic Propulsion.

JOURNAL OF THE BRITISH INTERPLANETARY SOCIETY
Volume 6, Number 4; March, 1947
This issue contains: Problems in Rocket Development and Zur Theorie Der Raketen.

JOURNAL OF THE BRITISH INTERPLANETARY SOCIETY
Volume 6, Number 5; June, 1947
Interplanetary Flight: Is the Rocket the Only Answer, Reviews, and a letter from Willy Ley.

JOURNAL OF THE AMERICAN ROCKET SOCIETY
Number 69; March, 1947
Includes: Commercial Applications of Rocket Power and Analysis of First Two American V-2 Flights.

JOURNAL OF THE AMERICAN ROCKET SOCIETY
Number 70; June, 1947
Among the articles featured are: The Liquid Propellant Rocket Motor and The Climate of Mars.

ROCKETS, Official Publication of the United States Rocket Society, Inc.
Volume 1, Number 6; May, 1947
Includes articles on: Extra-Tellurian Life Forms; Philatelic Notes; Your Own Meteor Crater.

REACTION RESEARCH SOCIETY

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The REACTION RESEARCH SOCIETY is a non-profit organization whose purpose is to aid in the development of reaction propulsion, its applications, and to promote interest in this new science. This purpose is carried out by maintaining an active research program, encouraging other experimenters, and promoting interest in reaction propulsion by the publication of ASTRO-JET, Journal of the Reaction Research Society.

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