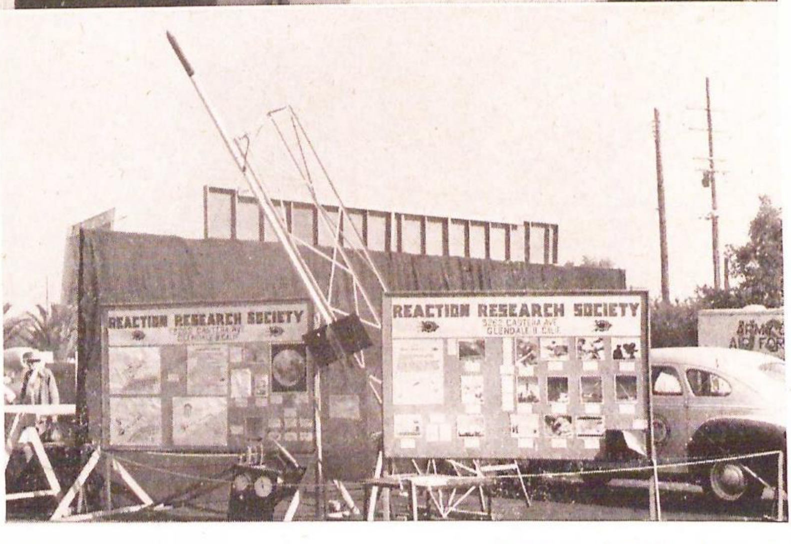
ASTRO-JET

JOURNAL OF THE REACTION RESEARCH SOCIETY

Number 23 Winter 1948

An Active Rocket Society



Photos by Carroll L. Evans, Jr.

Reaction Research Society public relations.

CONTENTS

THIS MONTH'S PICTURES

In the top photograph three Society officials examine a conception of a "space station," drawn by RRS Staff Artist Nick Stasinos. From left to right are: Arthur Louis Joquel II, Society vicepresident and public relations director; Nick Stasinos, staff artist; and George James, Society president and director of research. The space station is described in "Spaceward!", which is a transcription of a talk given by Joquel at the Headquarters Section in Glendale, California, on October 26, 1948.

The lower picture shows the Reaction Research Society exhibit at the Los Angeles County Fair, held at Pomona, California during September, 1948.

The drawing of the space station facing Page 14 was done by Nick Stasinos. The cut was loaned to the Society by the Northrup Aeronautical Institute of Hawthorne, California

EDITORIAL: 1948 — YEAR OF PROGRESS

— George James —

1948 was another year of intensive activity for the Reaction Research Society. A great number of accomplishments were made both in the fields of research and public relations.

Arthur Joquel presented the topic "PROSPECTS FOR INTERPLANETARY TRAVEL" at the technical meeting of January 13th while at the meeting of the 27th, color films of the V-2, WAC Corporal, and Research at the GALCIT Jet Propulsion Laboratory were shown.

"TESTING TECHNIQUES FOR REACTION PROPULSION UNITS" was presented by Jim Benson on February 10th. On the 23rd, Society members made a field trip to Cal-Aero Technical Institute. We were able to inspect their large collection of captured German jet and rocket units and were privileged to witness the static firing of a JUNO 004 jet engine. At the February 24th general meeting, color 16mm movies of the December 14th testing were shown.

March was the rocket mail month, for on the 9th, preliminary films were shown of Trona and the launching site; on the 28th the RRS successfully staged the largest rocket mail flight in history and on the 30th at the 5th Anniversary Dinner Meeting, films of the flight were shown.

Rocket mail continued to be the topic for April. At the meeting of the 13th, 16mm color movies of the mail flight were shown and it was announced that the delayed mail had finally been cleared. "Project Rocketpost," the promotion of interest in the long range transportation of mail by rocket, was announced at the April 27th general meeting.

David Elliott presented the topic "LIQUID PROPELLANT WORK" at the May 11th technican meeting. A membership meeting was held on the 25th.

"A PRELIMINARY INVESTIGATION OF INORGANIC PERCHLORATES AS SOLID PROPELLANT OXIDIZERS" was the topic presented by the author at the June 8th technical meeting. On June 22nd, a repeat showing was made of the three 16mm color films shown first on January 13th. The June issue of POPULAR SCIENCE carried an article on the RRS rocket mail flight.

An enjoyable time was had by the RRS members and friends attending the second annual RRS Picnic entitled "OPERATION MUSHROOM." The feature attraction of this picnic held on July 4th was a 140-pound pyrotechnic display piece appropriately called an "atomic" bomb. This display piece, prepared by the Reaction Research Division of the Rocket Engineering Company, performed very realistically, generating a 30 foot in diameter ball of multicolored fire which after a moment rose in true atomic bomb fashion and turned into an enormous mushroom-like cloud of white smoke. "PHOTOGRAPHY IN THE REACTION RESEARCH SOCIETY" was presented by Matt Jamgochian at the July 12th meeting. On the 13th the RRS held a combined meeting with the Los Angeles Astronomical Society at the Griffith Planetarium. Dr. R. S. Richardson spoke on "ROCKETS INTO SPACE." After Dr. Richardson's interesting talk, the new RRS interplanetary film, "TARGET FOR TOMORROW," was shown followed by the 16mm color Trona Mail Flight film. During July, the Society purchased some much needed equipment including a new 9" South Bend lathe, a new drill press, a power grinder, a new model 430 mimeograph machine and an Elliott addressing machine.

"WHAT YOU CAN DO FOR THE REACTION RESEARCH SOCIETY" was the topic of Carroll Evans' talk at the August 9th meeting. "REACTION PROPULSION AND

PYROTECHNIC SPECIAL EFFECTS IN THE MODEL FIELD" was presented by the author at the August 23rd model meeting.

Russell Sessing spoke on "BOOSTER ROCKETS" at the September 3rd technical meeting. The new standard rockets were discussed September 27th. During September the Society had an extensive display at the Los Angeles County Fair. The liquid propellant test stand, a solid-liquid engine, a launching rack, one of the mail rockets and much related material were on display. RRS Staff Artist Nick Stasinos prepared some very effective illustrations of Society work for this display.

On October 3rd, the firing of the first three standard rockets took place. Nick Stasinos presented "THE PLACE OF THE ARTIST IN THE FIELD OF REACTION PROPULSION" at the October 14th meeting. The most successful public meeting yet held by the RRS was on October 25th. The topic "SPACEWARD" was presented by Arthur Joquel, and over 110 people were in attendance. The Society design for a "space station," as drawn by Nick Stasinos, was shown, and the interplanetary film "TARGET FOR TOMORROW" was given its second public showing.

The films of the October 3rd testing were shown at the November 8th meeting, and on November 14th the second of the standard rocket firings was held. The new 16mm color information film "The REACTION RESEARCH SOCIETY" was previewed on November 22nd.

The November 14th films were shown at the technical meeting of December 13th. The first Annual Business Meeting as prescribed in the new RRS Constitution was held on December 27th. Reports were presented by the departments of Finance, Research and Public Relations. A film showing the highlights of the Society's 1948 research program was presented. The result of the annual election of Society officers was as follows:

President—George James

Vice President—Glenn Maxon

Secretary-Treasurer—Carroll Evans

During the latter part of 1948, the new RRS office was completed. This 12' x 14' building now houses all Society office equipment and records. It will also serve as a meeting room for committees and the executive council. The machine shop and chemical laboratory are in the process of being remodeled.

In addition to the Society field trips, several RRS members were given tours of AEROJET, the GALCIT Jet Propulsion Laboratory, POINT MUGU AND INYOKERN.

Although the 11 issues of RRS NEWS appeared at regular intervals, we fell extremely far behind in the publication of Astro-Jet. It is hoped this situation can be corrected during the coming year, 1949.

RESEARCH PROGRESS

Solid Propellants

During 1948 the Society launched fourteen solid propellant rockets. All of these were of the micrograin type. Eight rockets, similar to Big Boy (which rose to 5670 feet during 1947) were used on the mail flight. The other six rockets were of the new standard rocket type. The most significant new development on these rockets was the ball bearing launching clips which greatly reduced takeoff friction.

Of the eight mail rockets, all of which were launched at a 60° angle, one exploded (due to a thinner tube than used on some of the others); another burned a hole in the stainless steel propellant chamber about two feet from the top, and six made perfect flights. Seven of the rockets traveled about a mile and landed within a very close area. All of these rockets fired unevenly. However, it did not appear to affect their performance to any great extent.

One of the developments of this year was a standardized micrograin test rocket. These rockets, about 5 feet long and 2 inches in diameter carry a large payload compartment (3" x 8") for the testing of parachute releases and related mechanisms. The first three of the rockets performed very poorly--firing unevenly and for different periods of time. The second three, with a change in propellant load, performed in a very standardized manner—all three rising to altitudes of 1700 feet and firing for the same length of time.

Some short micrograin units were developed for the International Speedway Association for use in boosting some of their motorcycles. Some of the features on these rockets were a new, short time-lag, ignitor, (also used on the November 14th testing); a very short nozzle; special rupture disk and a propellant charge which is much easier to load into the chamber than many of the other micrograin rockets. From these motorcycle units, it was found that batteries of micrograin rockets can be fired side by side without one igniting the other.

It is hoped that the standard rockets will actually prove to be standardized. If so, research can then be devoted to other phases of solid propellant work. We are still lacking much information on the performance of micrograin rockets. We need more data on burning rate, specific impulse and chamber pressure. The phenomenon of micrograin burning has still to be explained in a more satisfactory manner. At the present there is evidence which would appear to indicate that the rocket fires as a restricted unit (combustion from one end of the propellant grain to the other end) (Continued on Page 24)

SPACEWARD!

— Arthur Louis Joquel II —

Rockets are first recorded in history as having been used by the Chinese. From the Chinese we also receive the proverb, "A journey of a thousand miles begins with a single step." So the civilization which gave the world this sage observation also, with their development of the rocket, took the first step toward the ultimate goal of rocket research—space travel.

It is another and longer step from the Chinese rockets of 1232 to the V-2 of 1948 — but the principle behind them both is the same. Also, they both have the same purpose—use for war. The rocket programs now being carried on at Point Mugu, White Sands, Wallops Island, Inyokern, and other testing sites have as their primary purpose the development of guided missiles for the next conflict.

But out of the military rocket research program may come valuable information which will be used in new rockets for peaceful purposes. V-2 rockets, roaring up to over 100 miles above the earth's surface, have immensely enlarged our knowledge of the conditions which surround our planet.

Cosmic ray counts, samples of rarefied atmosphere, temperature recordings, and many other types of information are radioed back from rockets which once rained destruction on cities —and which may do so again. But this data is essential to planning even the preliminary assaults upon outer space.

If it has taken centuries to evolve the 100-foot-long rocket which is alleged to be in existence at "a research base on the Mojave desert," from now on reaction research should progress more rapidly. The Viking -- formerly known as the Neptune — is ready for its first test, if that test has not already been held. This American-built rocket is expected to reach an altitude of 240 miles.

This is only one one-thousandth of the distance to the moon — but the moon is only a few more steps away. Willy Ley, pioneer rocket researcher, pointed out several years ago that the space rocket would be simple after smaller rockets had passed the 200,000-foot altitude mark. The basic research is now complete. The lunar rocket -- long talked about and dreamed of by rocket amateurs and professionaly alike— is only years distant.

Furthermore, this event is not dependent on the development of atomic power. There are rocket fuels now in existance, such as penolite, developed by Dr. Fritz Zwicky, California Institute of Technology professor, which are powerful enough to enable a rocket to break free from the earth's gravity and travel into space.

We can outline quite clearly the steps which will be taken. We have mentioned the Viking rocket, which is about 45 feet long. This rocket has a single rocket engine, and will probably attain a speed of over a mile per second—the velocity now reached by the V-2—in its dash to an altitude of over a million feet.

A rocket of the same approximate length, but built in four steps or sections, each one to be discarded when its fuel supply was exhausted, could probably impart a speed of five miles per second to the fourth and final step.

Fired to an altitude of 200 miles, the section of the rocket containing recording and transmitting equipment would take up a perpetual orbit around the earth, like a tiny moon, upon attaining the five-mile-per-second velocity. It would circle the earth in about one and one-half hours.

The data which would be telemetered back from the instruments in this permanent orbital rocket would compare with the V-2 recordings which are now being made much as a motion picture film compares with a snapshot. Data secured by the V-2 covers a period of a few minutes. The orbital rocket would provide a continuous picture of conditions approaching those in outer space.

A few years ago, Army technicians found that radar waves could penetrate the Heaviside layer, which deflects radio waves back to earth, and reach out to bounce off of the moon. The practical uses of this achievement were not immediately apparent, but it now attains importance in connection with the next stage of progress.

This step, great as it may seem, is to send an unmanned rocket around the moon. The mechanisms on this rocket would be partly automatic and partly actuated by radar impulses from surface stations. There would be no attempt to land such a rocket on the moon's surface, as this would serve no useful purpose.

But the information which would be brought back by such a rocket would be of extraordinary value. Automatic camera photographs of the far side of the moon, which is never visible from the earth, would be some of the most interesting if not the most valuable results of such a flight.

The data from a number of circum-lunar rockets would have to be studied and evaluated before the next step could be taken — the construction of a space rocket to carry one or more passangers. The danger of a meteorite striking a space ship, the extreme temperature zones which surround the earth, possible unknown effects of cosmic radiation, and many other factors would have to be considered before a manned space rocket could be built and launched.

The size and shape of the manned space rocket are matters which will also have to be determined from future research. There is a considerable difference between a payload of instruments, weighing about 100 pounds, and the life-sustaining essentials which a manned rocket would have to carry.

Such a rocket at present would have to be a monstrous structure, even to make the trip with a crew of only two men. But the development of more powerful fuels than even exist at present may help in cutting down the take-off weight. And while we have stated that fuels exist which can attain the exhaust velocities necessary to break free from the earth's gravitational pull, the development of atomic power would naturally simplify the problem at one stroke.

The shape of the space-ship may be considerably different from any of the ideas which have achieved popularity. Dr. Dinsmore Alter, director of Griffith Observatory, has pointed out that since the journey through the earth's atmosphere will only last a very short time, there is no need for the consurtction of a streamlined vessel, and the most logical shape for a spaceship — the shape permitting the maximum content in respect to the area of the hull— is a sphere.

Various other shapes have been proposed for space rockets, including one which greatly resembles a gigantic doughnut. However, it seems probable that the first space rockets will be built in the "classical" design—torpedo-shaped, with the rocket orifices at the rear and the crew's quarters in the nose of the spaceship.

These first manned rockets would also confine their flights to circling the moon and returning to earth. It would not be until several of these flights had been successfully accomplished that an attempt would be made to make the first landing on the surface of the moon.

The problem of return from the moon is almost easier than that of leaving the earth. A rocket to escape from the gravitational field of the earth must attain a speed of seven miles per second. After the initial expenditure of fuel to reach this velocity, the rocket would coast through space until time to begin the necessary landing maneuvers.

Gravity on the moon is only one-sixth as strong as that of the earth, which means that a velocity of one mile per second — already attained by the V-2! — would suffice to release such a rocket from the moon. Obviously, therefore, proportionately less fuel would be needed.

The problem of the initial rocket to land on the moon has been studied by G. Edward Pendray, rocket authority, who believes that the number of persons in the crew does not need to be more than five. He suggests a pilot who will also be the navigator; a copilot who will be a mechanic engineer; a specialist in geology and minerology; a physicist-chemist who also is an expert on radio and radiation; and a medical authority. This group would spend nearly a month on the lunar surface, gathering data, and would then return to earth.

The first base on the moon would probably be in the form of a small, compact group of buildings, entirely enclosed in a curved plastic dome, to hold air imported to this airless world, so that the staff could work unhampered by the airtight suits necessary for making any excursions over the moon's surface. Enlargement of such a base would be done by connecting other groups of adjacent enclosed buildings by pressurized tunnels.

Astronomers have long speculated upon the opportunities for research which would be available to them from an observatory on the moon. With no atmosphere to disturb their "seeing," a small telescope could do the work of a much larger one on earth. The sun's corona would be constantly visible, instead of appearing only during solar eclipses as at present. Stellar research would be immeasurably advanced by the ideal conditions available on our satellite.

It seems probable that rich finds of minerals could be made on this new world. The possibility of locating deposits of elements which are rare or which are being exhausted on earth should also be considered. Many opportunities for commercial development could be discovered.

While the moon has been suggested as a possible military base for use against the earth, recent investigations, such as those by Dr. R.S. Richardson, Mount Wilson astronomer, would seem to relegate this possibility to a rather remote position. An attacker from the moon would stand almost as much chance of hitting his own country with a rocket as he would of striking his proposed target.

A base on the moon would be almost mandatory before larger rockets attempt the longer trips through space to Mars and Venus. The less fuel needed to start such rockets on their journey, means more space for necessary supplies —air, food, equipment of all kinds—in the limited area available inside a spaceship.

The problems of navigating a space vessel—first from the earth to the moon, and later to the planets—with the associated problems of takeoff, flight, and landing maneuvers and orbits, is already under serious study. The University of California at Los Angeles has for several years presented a course in rocket navigation, headed by Dr. Samuel T. Herrick.

The British philosopher and sociologist, W. Olaf Stapledon, recently suggested that the colonization of Mars should be undertaken by natives of the Tibetian plateau, since the region bears an excellent resemblance to conditions which exist on Mars — thin, dry air, temperatures which drop far below zero at night, and other similarities.

If Venus is a hot, moist, swampy planet, as some astronomers believe—there is considerably more doubt about the state of things there than on Mars—the ideal colonists would be drawn from earth's tropical zone, so as to lessen the difficulties of acclimatization to an alien environment.

One of the matters which will have to be brought before the governments of the world at some future date will be the rights of possession on other planets, assuming that such planets are not already inhabited by intelligent beings. There would probably be room enough for everyone, however, as explorations of a planet like Mars would take decades, even with the use of the most modern methods and equipment.

There is no end to the speculations which may be indulged in about the possibilities of finding life—perhaps intelligent life—on other planets. But this theme must remain in the realm of intellectual exercise only, until contact with these planets is actually made.

However, the imagination cannot resist being stimulated by thoughts of interplanetary archaeology, biology, paleontology, and other sciences waiting to be opened up by expeditions from earth.

When we reach this stage in the evolution of space flight, the use of atomic power will become necessary. The passenger cabin in such space ships will probably resemble the interior of a railway coach of today, with a comparable lack of comfort and spaciousness. Space travel will certainly not present all the proverbial comforts of home.

Since there will be a considerable traffic between the earth and the moon, we can foresee the establishment of "space stations," to serve as intermediate bases for these rockets. Such a station would be assembled piece by piece out in space, with parts being brought up from the surface of the earth by cargo rockets.

If such a station were situated about 24,000 miles from the surface of the earth, it would remain permanently above a given point on the earth's surface, because its rotation around the earth would exactly match the 24-hour revolution of the earth on its axis. Such a space station could be located above every large city.

Such stations would vary in size according to their purpose, but would probably be shperical in shape, with groove-shaped docks in which spaceships would rest so that their air-locks would open directly into the interior decks of the station. The top deck of the station would be covered with a curved plastic dome, under which plants would be grown either in soil or hydroponically.

These plants would serve the double purpose of producing food and refreshing the atmosphere in the station, as they would convert the carbon dioxide breathed out by the crew and passengers into oxygen for further use. The space station would serve two main purposes. It would be a stopping-place for rocket passengers bound for the moon, where they could exercise, relax, and have a square meal before setting out on the major stage of their journey.

The space station would also serve as an observation post for many services on earth. Storms could be observed from their beginnings,


BY NICK G. STASINOS

and comprehensive weather forecasts made. The movement of icebergs in the northern seas could be followed and warnings issued to shipping. Much could be learned about the aurora and other mysterious phenomena which now perplexes the specialists in half a dozen sciences.

We have moved rapidly in our discussion of the possibilities of space travel. As we have said, the basic knowledge is already at hand. All that is required is the interest and the financing. Space travel will come — but will it come soon enough. At this point, a discussion of the sociological implications of space flight is necessary.

In the dawn of recorded history, the family was the fundamental unit of existence. And by its nature, the family was confined more or less to a very small area on the earth's surface. When, at a later period, a number of families united to form a clan, this expansion was generally along a migratory path, in a single line.

Still later, groups of clans united to form city-states or tribes. These spread out over the surface of the earth in all directions from a center, until they encountered the boundaries of another similar unit.

Almost simultaneously with the emergence of nations in the form which we know them today, as a result of the amalgamation of lesser divisions, another expansion took place—into the air and under the sea. Mankind had attained a three-dimensional existence through his repeated expansions.

Now, with the development of an international consciousness, if not an international government as yet, we find national and social tensions mounting all over the world. And at the same time, we can observe that the boundaries of the known world have now become fixed — there is no longer room for expansion.

In the past there has always been room for pioneers to open up new geographical frontiers. Today, almost all of the habitable portions of the globe are occupied or claimed. There is no place left for the adventurous individual or group to go, except off the surface of the earth to the other planets.

While population movements like that of the early American colonists have never stopped war, they have often delayed it for a time. The immense advance in the destructiveness of war has coincided with the end of the time when people could move to new territories and make a fresh start.

The threat of war now hangs heavily over all the nations of the world. But if a rocket ship reaches the moon before the third world war breaks out, the war will probably be averted. The world-wide wave of enthusiasm over this great accomplishment would turn the minds of individuals and nations to this new horizon, and the race for other worlds would be on — and in rocketry there are no secrets such as are supposed to exist in atomics.

The military rocket program at White Sands, New Mexico, is continually receiving offers from persons who are willing to go aloft in a V-2 rocket in the interest of science, even though they know it means their disability or death. The volunteers to man a space rocket would probably run into the thousands.

And these will include women as well as men. In fact, some scientists believe that the female body could withstand acceleration shock and pressure better than the male. This is an adventure to be undertaken by men and women together, just as all such pioneering has been done in the past.

Alfred Korzybski, director of the Institute of General Semantics, has pointed out that science advances in a geometrical progression, doubling at every step, as: 2, 4, 8, 16, 32, etc. Sociology, however, up to now has only advanced in an arithmetical progression, adding at each step, as: 2, 4, 6, 8, 10, etc.

When technology gets too far ahead of politics, a war ensues, during which the two factors are violently pulled into temporary coincidence. Then the cycle begins again, and this is repeated over and over — but always the period of revolution or war increases in both length and violence with each succeeding jump.

The world has now reached the point where another war may be disastrous to the future of mankind. The potential of destruction is greater than ever before in history. Efforts are being made to overcome this discrepance between science and sociology — the two main facets of twentieth century existence—but a new war would be fatal to these endeavors. The development of space travel, offering a new release for the ideals and ambitions of mankind, might provide the delay necessary for these measures to be brought into effect.

This is a matter which affects us all—amateur and professional rocketeer, civilian and technician alike. The development of the airplane was retarded for years because of a lack of general interest. Rocket researchers must keep the public informed of and interested in their work as it progresses, so that the world will be prepared for the inevitable developments in this field.

Mankind is engaged in a race between progress and catastrophe. The suggestion we have made is not the only answer — but it may be one of the answers to the problem. For one pair of eyes now turned spaceward, there must be thousands very soon. For here is our tomorrow—here is our new frontier. ###

NEW JET PROPULSION LABORATORY ESTABLISHED

AT CALIFORNIA INSTITUTE OF TECHNOLOGY

A national center of rocket and jet propulsion study and research, to be known as the Daniel and Florence Guggenheim Jet Propulsion Center is to be established at the California Institute of Technology, it was announced jointly by Dr. Lee A. DuBridge, Caltech president, and Harry F. Guggenheim, president of the Daniel and Florence Guggenheim Foundation, on December 14, 1948.

This is one of two such centers to be established in this country, the other to be at Princeton University, Mr. Guggenheim stated. The Foundation has appropriated $500,000 to support the two centers for a seven year period and the Pasadena Center will thus operate on a budget of approximately $30,000 a year.

Simultaneous with the announcement of the establishment of the center at Caltech, Dr. DuBridge also named Dr. Hsue-Shen Tsien, 38-year-old native of China, former student and member of the Caltech aeronautics faculty to head the Pasadena center. Dr. Tsien is now professor of aerodynamics at the Massachusetts Institute of Technology.

In commenting upon the establishment of this new research and study center at Caltech, Dr. DuBridge said:

"The basic research to be carried on at these centers will accelerate the application of the principles of jet propulsion to peace-time commercial and scientific purposes. The Jet Propulsion Center at the California Institute of Technology will be a logical and desirable extension of the research program of the Institute relating to all aspects of aeronautics.

"It will establish on the campus a center of study and research which will complement work being carried on under government contract at the present Jet Propulsion Laboratory, and in the present Guggenheim Aeronautics Laboratory.

"The Daniel and Florence Guggenheim Foundation is making a most significant contribution through the establishment of these two Jet Propulsion Centers. They will go far toward improving our understanding of the basic scientific phenomena underlying jet and rocket propulsion. A particularly important phase of their work will be the training of young scientists in this field.

"Establishment of this center on the Caltech campus will not necessitate new buildings or new laboratories. The work of the Center will be primarily analytical, theoretical and educational, and will concern the basic problems in jet and rocket work. There will be no making and firing of experimental jet or rocket motors on the campus in connection with this activity. The analytical and theoretical research to be done on the campus will be complementary to experimental work carried on at the Jet Propulsion Laboratory in Arroyo Seco."

In announcing the establishment of the Jet Propulsion Centers, Mr. Guggenheim said, "The California Institute of Technology was chosen for this vital research work in the west because it was a center of rocket development prior to and throughout the war, and is the site of the Jet Propulsion Laboratory at which it is carrying a major research load in connection with the Armed Forces' guided missile and jet propulsion program.

"Jet propulsion has opened a new era in engineering and in human thought, and will affect the future of the world more profoundly than any one can foresee today.

"The Daniel Guggenheim Fund for the Promotion of Aeronautics contributed after the first World War to commercial aviation development in the United States. It was this commercial aviation development that was the basis for our supremacy in the air in World War II.

"In establishing these Jet Propulsion Centers, the Daniel and Florence Guggenheim Foundation is endeavoring to contribute in a similar way to the development of the peacetime applications of jet propulsion and the rocket."

The object of the centers is three-fold, he said:

"They will serve as training centers for leaders of the future in the field of rocket technology. They will serve as centers of research and advanced thinking on rocket and jet propulsion problems. And they will be centers of leadership in the development of peace-time commercial and scientific uses of rockets and jet propulsion."

The $500,000 fund allocated by the Foundation for the initial seven year period will be used to pay salaries of professors, stipends of graduate students, and research expenses. It does not provide for buildings or major equipment, since these are already available at these two institutions.

The principal post in each center will be a professorship, named in honor of the American rocket pioneer, Dr. Robert H. Goddard. With each of the Goddard professorships there will be associated a number of post-graduate fellowships, at least three of which will be granted each year by the Foundation, and which will be known as the Daniel and Florence Guggenheim Jet Propulsion Fellowships. They will carry a stipend of up to $2,000 a year each, and will be granted for two-year study leading to a doctor's degree. They will be awarded to unusually promising graduate students in jet propulsion, following an annual nation-wide search for the best available candidates.

In announcing the appointment of Dr. Tsien as the Robert H. Goddard Professor at Caltech, Dr. DuBridge said, "We are indeed fortunate in being able to obtain Dr. Tsien for this post. He is considered one of the most brilliant scientists in this field in the world today, and his acceptance of this position assures the kind of leadership both the Foundation and Caltech are seeking for this new research center."

Dr. Tsien obtained his Doctor of Philosophy degree in Aeronautics, magna cum laude, from Caltech in 1939. His thesis was on "Problems in the Motion of Compressible Fluids and Reaction Propulsion." He remained at the Institute as a research fellow and in 1943 was appointed assistant professor in aeronautics. He was promoted to associate professor in 1945.

During the War, he distinguished himself as a contributor both to theory and research in the problems of supersonic flight and jet propulsion. He served with Dr. Theodore von Karman, Director of Caltech's Guggenheim Laboratory of Aeronautics as a member of the Scientific Advisory Board of the Air Forces.*

He is at present professor of aerodynamics at the Massachusetts Institute of Technology, from which position he will return to Caltech next summer as Goddard Professor.

---

* See also "Research and Development at the Jet Propulsion Laboratory, GALCIT," released by the Committee on Publications and Publicity of the California Institute of Technology, and published by the Reaction Research Society in 1946.

BOOK & MAGAZINE REVIEWS

— Arthur Louis Joquel II —

ROCKET DEVELOPMENT: Liquid-Fuel Rocket Research, 1929-1941. By Robert H. Goddard, Ph.D., Sc.D. Edited by Esther C. Goddard and G. Edward Pendray. Prentice-Hall, Inc., 1948. $6.50.

This collection of data written by the late Dr. Goddard on his experiments marks the first material released on his researches since 1936. As such, it is the forerunner of a series of publications which will include material from Dr. Goddard's notebooks, reports, manuscripts, patents, diaries, correspondence, and other sources.

According to the Introduction by Mr. Pendray, the summaries of the experimental notes from which this book was prepared were made by Dr. Goddard in 1944 and 1945. They begin after the historic flight of July 17, 1929, and continue up to an attempted test flight on October 10, 1941, after which the experiments were terminated because of the imminence of the second world war.

The table of contents provides an excellent description of the book. The chapters are: 1. Tests Conducted at Camp Devons, Mass., for Improvement of Liquid-Fuel Rocket-Motor Efficiency; 2. Early Experiments in New Mexico; 3. Work on Rocket Problems at Clark University; 4. Tests Resumed in New Mexico, with Simple Pressure Fuel Feed, Flight Control and Parachute; 5. Tests for the Development of a More Powerful Motor; 6. Flight Tests with 10-inch-diameter Motors, in Nitrogen-Pressured Rockets; 7. L-Series Flight Tests Continued, with 5-3/4-inch-diameter Motors; 8. L-Series Flight Tests Concluded, with Rockets Pressurized by Liquid Nitrogen; 9. Experiments Toward Development of Propellant Pumps; 10. Static Pump Tests Continued; 11. Conclusion of Pump Tests for the Purpose of Developing a Pump-Driven Flight Rocket.

It is to be regretted that the extremely laudatory prefatory note by Mr. Harry Guggenheim attempts to build up the "Goddard Legend" by attributing to Dr. Goddard an extent of influence which he would undoubtedly have modestly disclaimed. Dr. Goddard's place in rocket history is secure enough without the necessity of any apochrypha to aid it.

JOURNAL OF THE BRITISH INTERPLANETARY SOCIETY
Volume 7, Number 1; January, 1948
With this issue, the BIS Bulletin is discontinued, and the BIS Journal becomes a bi-monthly. "Conditions on the Surface of Mars," by M. W. Wholey, and "The Interplanetary Project," by A. V. Cleaver, are the principal articles in this issue.

JOURNAL OF THE BRITISH INTERPLANETARY SOCIETY
Volume 7, Number 2; March, 1948
"Electronics and Spaceflight," by Arthur C. Clarke, and a long article by M. W. Ovenden, F.R.A.S., on "Recent Developments in Astronomy," feature this issue, which also contains a table of the German "A" rocket projects, the "A-4" of which is commonly known as the "V-2."

JOURNAL OF THE BRITISH INTERPLANETARY SOCIETY
Volume 7, Number 3; May, 1948
A cynical "Autopsia" by P. E. Cleator leads off this issue, the main items of which are "The Man-Carrying Rocket," by R. A. Smith, and a highly technical article by D. F. Lawden, M.A., on "Initial Arc of the Trajectory of Departure." The film "Development of Rocket Flight," produced by the British Ministry of Supply, is also reviewed.

JOURNAL OF THE BRITISH INTERPLANETARY SOCIETY
Volume 7, Number 4; July, 1948
"High Strength Hydrogen Peroxide for Rocket Propulsion," by V. W. Slater and W. S. Wood, and "Expendable Rockets," by Kenneth W. Gatland, feature this issue.

JOURNAL OF THE BRITISH INTERPLANETARY SOCIETY
Volume 7, Number 5; September, 1948
The first installment of "The Atomic Rocket," by L. R. Shepherd and A. V. Cleaver, a discussion by Arthur C. Clarke of "The Problem of Dr. Campbell," (the slightly myopic president of the Royal Astronomical Society of Canada), and an article on "The U. S. Naval Ordinance Test Station at Inyokern," by L. J. Carter, F.R.S.A., A.C.I.S., are the major features of this issue.

JOURNAL OF THE BRITISH INTERPLANETARY SOCIETY
Volume 7, Number 6; November, 1948.
The major portion of this issue is given over to W. Olaf Stapledon's paper on "Interplanetary Man," which made newspaper headlines when it was presented before the BIS. The second installment of "The Atomic Rocket" is also included.

EDITORIAL — PROGRESS DURING 1948

(Continued from page 6) since we can predict firing time with fair accuracy by knowing the length of propellant charge. However one of the mail rockets burned a hole in its propellant chamber 8 feet from the nozzle end only .5 sec. after beginning to fire. If the propellant burned linearly, it should have taken about 1.5 seconds for combustion to reach that point. Possibly the propellant charge ignites and burns on all surfaces as in an unrestricted rocket.

In the Spring issue of Astro-Jet, the continuation of this discussion will include RRS plans for 1949 and work on other solid, solid-liquid and liquid propellant systems.

REACTION RESEARCH SOCIETY

PURPOSE

The REACTION RESEARCH SOCIETY, founded in 1943, is a non-profit organization whose purpose is the development of reaction propulsion and its applications, the promotion of interest is this science, and its allied educational and technical activities.

MEMBERSHIP

At the present time there are two main classes of membership in the Reaction Research Society, Active and Associate. Active membership is for the interested and qualified persons who by their membership indicate their willingness to engage in the activities of the society. Active members hold full scientific or research membership in the society and have the privilege of attending meetings and testings of the society. Active members receive all society publications published during their membership and are eligible to conduct society sponsored research and to hold office in local society groups. This class of membership is $5.00 per year. Associate membership is for those interested and qualified persons who find it inconvenient to devote sufficient time on work of the society to warrant an active membership. They have all the privileges of active members except holding office in local society groups, serving as a project or testing chief or in any other manner being in charge of a society technical or scientific research activity. This class of membership is $3.00 per year. If you are interested in joining the society, please write to:

SECRETARY, REACTION RESEARCH SOCIETY
3262 Castera Ave., Glendale 8, California

OFFICERS

President and Editor .... George S. James
Vice-President .... Arthur Louis Joquel, II
Secretary-Treasurer .... Robert J. DeVoe

ASTRO-JET is the official publication of the REACTION RESEARCH SOCIETY, 3262 Castera Avenue, Glendale 8, California. ASTRO-JET is published four times a year. Subscriptions are $1.50 per year, single copies are $.50 for the current issue and $1.00 for back copies. Statements and opinions expressed in ASTRO-JET do not necessarily reflect the views of the society.