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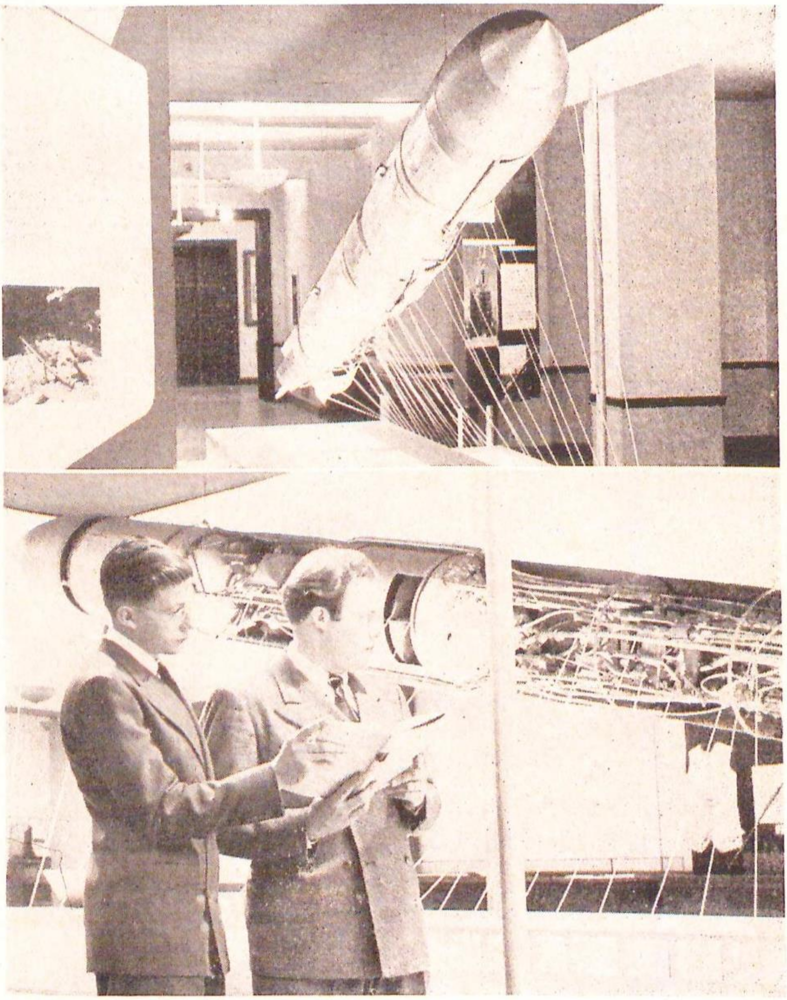
An Active Rocket Society



Dr. Robert H. Goddard Exhibit
Los Angeles County Museum

C[illegible]

Arthur Louis Joquel II, Editor

THIS MONTH'S COVER PICTURES

(ABOVE) Front view of a rocket built by Dr. Robert H. Goddard in 1941. The rocket was included in a display honoring the late American rocket pioneer which was held at the Los Angeles County Museum under auspices of the Daniel and Florence Guggenheim Foundation. (BELOW) George James, president of the Reaction Research Society, and Arthur Louis Joquel II, director of "Project Spaceward," examine the construction of the rocket, using Dr. Goddard's own writings as a descriptive text. ###

SPACE TRAVEL

AND THE NON-PROFESSIONAL ROCKETEER

— Arthur Louis Joquel II —

Those of us who are firm believers in the future development of rocket travel to the Moon and the planets are constantly being asked, "Why do you spend your time on something that is so far in the future? What can a comparatively small civilian non-professional rocket society do that will be worthwhile to promote space travel? Why not forget these dreams and devote your time to something more practical?"

The idea that only a multi-million-dollar enterprise, such as a national government, will ever be able to construct and launch an interplanetary rocket has been repeated so often and so positively that most rocket experimenters seem to forget that there are a great number of factors involved in such a project. It will take a great amount of money to build the first moon rocket, it is true. But what about the preliminary research and, almost more important, the preparation of the public mind for such an epochal event?

Almost all of the great inventions and developments of the past have had to fight their way against severe odds until they were finally accepted. A young Army officer who suggested that an observer should be sent to the first flight of the Wright Brothers airplane in 1903 was nearly courtmartialed by his superior officer, who vociferously expressed his belief that men would never be able to fly. The pages of history are filled with similar incidents.

Rockets already have a backlog of acceptance in the popular mind, but in a large number of cases they are concerned with war and destruction. The energetic military program, news of new and more destructive guided milliles, and a bad case of fright over the present international situation do not help to make the average person feel too enthusiastic over the prospect of sending a rocket to the moon.

The excellent public relations which the Reaction Research Society has enjoyed during the past several years can be cited as proof that there is a large interest in rocket development for peace. In a world which is bombarded every day by news of ever more frightful weapons, the thought of converting one of these weapons to a pacifistic use seems to have a great appeal.

And while rockets have a number of applications dealing with mundane affairs, such as making meteorological surveys, the carrying of mail, and other such uses, the rocket will not really come into its own field until it reaches out into space, where no other vehicle can follow.

We are standing at the threshold of the "Space Age." Various estimates of the time required to build the first moon rocket vary according to the amount of money considered necessary to build the rocket, but they range from a year to ten years. Only the uninformed or the obstructionist can believe that no effort will be made in the very near future to reach out to our neighbor worlds in space.

And because of the military mania for unnecessary secrecy, even in matters regarding which there is and can be no secret, it becomes the duty of the civilian rocket groups to pave the way for the space rocket. If the problem of building one is beyond them, they must put their efforts into bringing about the public acceptance of the inevitability of the fact -- that interplanetary travel is a thing of tomorrow. ###

ROCKET RESEARCH AIDED BY

NEW UPPER ATMOSPHERE STUDIES

Important new facts about the outer reaches of the earth's atmosphere have been brought to light as a result of studies conducted by the RAND Corporation, a non-profit organization of scientists doing research for government agencies.

Until 1940, the properties of the atmosphere were well known up to altitudes of approximately 11 miles (60,000 feet). The Rand study, utilizing all available channels of information and scientific deduction, encompasses not only the high realms of the atmosphere but even the areas just beyond, where it has been ascertained that an extremely rarefied hydrogen gas exists at the tremendously high temperature of 18,000 degrees F.

The study has revealed, moreover, that above an altitude of 50 miles, where the temperature is quite low--minus 50 degrees F.—the atmosphere rapidly begins to grow hotter, reaching a level of 4,000 degrees at a point about 400 miles above the earth. Beyond that it remains uniform to its outer edges.

Knowledge that these high temperatures exist is extremely important, inasmuch as it indicates that the atmosphere extends a distance of 10,000 to 15,000 miles outside the earth—much farther than had previously been estimated.

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* "Analysis of Temperature, Pressure and Density of the Atmosphere Extending to Extreme Altitudes," by G. Grimminger (The Rand Corporation, 1500 Fourth Street, Santa Monica, California, 1948; $2.85).

The same analysis has been carried out for the upper atmosphere above the earth at the equator and the middle latitudes, but not above the polar regions.

Although very high temperatures exist in the outer atmosphere, it must not be inferred that objects such as meteorites, passing through these "hot" regions, are heated by this air. At these altitudes the atmosphere is so rarefied that it would have no effect in transmitting its temperature to a solid body, but rather the temperature of a body would be determined entirely by other factors, including the radiation it receives from the Sun and loses to space. It is only at much lower altitudes, at about 60 miles, that the atmosphere becomes sufficiently dense to cause the incandescent heating of a meteorite.

The studies also indicate how the atmospheric gases are distributed with altitude. The main constituents of the atmosphere at sea level are nitrogen and orygen, and these gases remain in about the same proportion up to an altitude of 200 miles. At higher altitudes the relative amount of nitrogen increases, and between 2,000 and 3,000 miles altitude the at,osphere is composed almost entirely of nitrogen. Above 4,000 miles the amount of nitrogen decreases very rapidly, and it is mainly hydrogen, together with some helium, which forms the remainder of the atmosphere. While some of the hydrogen and helium atoms undoubtedly escape from the earth's atmosphere into interplanetary space, this loss is compensated for by the continual release of helium at the surface of the earth from chemical processes, and possibly by the hydrogen atoms which enter the atmosphere from interplanetary space.

At an altitude of 10,000 miles the atmosphere is so highly rarefied that the pressure is almost a billion billion times smaller than it is at sea level; that is, many times less than the lowest pressure attainable with the very best high vacuum pump. In this region there are about one million atoms of air per cubic foot, which means that the atoms are about 1/8 inch apart. However, the atoms themselves are so small that under these conditions they travel about 10,000 miles before colliding with another atom.

It is interesting to point out how these high atmospheric temperatures are deduced. As a result of the action of the ultra violet rays from the sun, the high level atmosphere is strongly ionized—which means that electrons have been stripped from the atoms and molecules of the atmospheric gas. Because of this property, this region of the atmosphere is called the ionosphere. These electrons then bounce around freely in the atmosphere and form a gas of their own. This gas of free electrons has a marked effect on certain radio waves and causes them to be reflected in the ionosphere and be directed back to the surface of the earth. The high atmospheric temperatures can be determined from experiments with these radio waves together with the application of the atomic and kinetic theory of gases. The fact that the temperature remains constant at this high value from 400 miles out to interplanetary space is deduced from the kinetic theory of very rarefied gases and the fact that the individual atoms of air in this region rise and fall of enormous distances, like tiny bodies in free flight, before they collide with another such atom.

The results of the Rand study are expected to be of great value to scientists throughout the country who are engaged in research in meteorology, physics, astronomy, electronics, and aerodynamics.

SOCIETY MEETING [illegible]

DR. ROBERT H. GODDARD

Southern California rocket enthusiasts and technicians held a meeting at the Los Angeles County Museum on February 4, 1949, to honor America's pioneer rocket experimenter, the late Dr. Robert H. Goddard, whose work lies back of many present-day accomplishments in the field of rocket-propelled missiles.

The evening's program was sponsored by the Reaction Research Society in cooperation with the Museum, where an exhibit of Dr. Goddard's work, sponsored by the Daniel and Florence Guggenheim Foundation, was being shown.

Two of the Society's foremost technicians spoke during the program, which was presented in the Museum's lecture hall. George James, president and research director, discussed "The Results and Significance of Dr. Goddard's Rocket Research," while Arthur Louis Joquel II, director of the Society's "Project Spaceward," spoke on "Rockets and the Future."

Three motion pictures were shown, dealing with German V-2 research, the American WAC Corporal rocket, and the work being carried on by the Reaction Research Society. Over eighty persons attended the meeting.

A feature of the session was a visit to the Goddard exhibit, where Society representatives described the material on display and discussed the work of Dr. Goddard and its significance in the light of recent developments in this field.

The exhibit included two large rockets, cut away on one side to show their interior construction, and a number of other items, including the world's first liquid-fuel rocket, which was flown by Dr. Goddard on March 16, 1926.

ROCKET MAIL EXPERIMENTS IN HOLLAND

PROF. DR. A. J. DE BRUIJN

At some date not too far in the future when industrious historians begin to collect and write the story of how mail was first sent by rocket, an outstanding place in the records of both Holland and the world will be allotted to Prof. Dr. Adam J. de Bruijn.

For more than twenty-five years, Dr. de Bruijn has carried on experiments with rockets for peaceful purposes. Working with very limited finances, he has succeeded during that time in calling international attention to the possibilities of sending mail by rocket. Special rocket mail stamps and flown covers representing his work may be found in many collections.

He has received honors from many European societies, including the "Commandeur dans l'Ordre Universel Merite Humain" at Geneva in 1947, "Membre d'Onore Universitario e Accademi Venetie," and many others.

Dr. de Bruijn's work began on September 16, 1921, when he made his first rocket flight; and he founded the Nederlandse Ruimtevaart Studio in the same year. From its present address at Rooseveltlaan 136, Amsterdam Z.2, the studio, under Dr. de Bruijn's direction, is carrying on both research and public relations work in the field of rocket mail.

Before the beginning of World War II, the rocket flight held by Dr. de Bruijn which attracted the most public attention was the one held on January 24, 1935. Following some experiments in 1934, the 1935 flight received a good deal of notice, including being featured in a "Polygon" sound news reel which was shown in all of the important theatres in Europe.

The rocket used during this flight was the R 264, a two-foot projectile fired from a lightweight launching rack. The trajectory of the rocket was quite high, and, as was the case with many early rocket experiments, the firing crew and spectators were permitted quite close to the rocket during the firing. The flight was made from Katwijk to Zee, and the envelopes carried all bore a special semi-postal stamp.

Continuing his work, Dr. de Bruijn built and fired nine rockets during the years of 1936 to 1938. All of these carried small numbers of letters. The distance covered by these rockets was not large—the farthest went 3 kilometers — but of the nine flights, all but one were successful.

His practical work being forbidden during the German occupation of Holland, Dr. de Bruijn was forced to discontinue these flights for the duration, but resumed them as soon as circumstances permitted, firing a rocket carrying 299 letters a distance of 3.6 kilometers on May 7, 1945, and following this in the next six months with no less than sixteen other flights, carrying various amounts of mail.

A special flight to commemorate the liberation of Holland was planned for September 26, 1945, but the Government authorities considered that there was too much risk to traffic passing on the roads near Hilversum, site of the launching. Permission for the flight to be held on an area of heathland on October 17 was finally granted, but as the space chosen by the authorities was not large enough, it was necessary to add several kilograms of deadweight to the rocket so as to limit the flight distance.

Even with this handicap the rocket, which used a new liquid fuel, made a flight of 7.1 kilometers, being fired at 3:27 p.m. The cargo of 1195 letters arrived almost intact, about 50 of the letters which were in the bottom of the mail compartment being damaged by the intense heat from the new propellant. This flight was the 416th held by Dr. de Bruijn, and as with all of the other mail flights, the letters carried special stamps and cachets.

After six more flights during the ensuing year, Dr. de Bruijn celebrated his silver anniversary of rocket experimentation. The Nederlandsche Ruimtevaart Studio prepared a special stamp with his picture, and a flight was held on September 16, 1949—twenty-five years after the pioneer experiment which he made as a youth of twenty-one.

Dr. de Bruijn's activities are not confined strictly to research. He also publishes a magazine which carries news of his own and other rocket activities, written in four languages—Dutch, English, French, and Esperanto. The recent IMABA philatelic exposition held at Basle, Switzerland, included a large exhibit of his stamps and flown covers.

While carrying on this work, Dr. de Bruijn, like many other rocket experimenters, looks forward to the day when rocket mail will flash in a few minutes across continents and oceans.

TOP LEFT: Cover flown from Auberge to Dinant, March 19, 1946. MIDDLE LEFT: Cover flown September 20, 1945. BOTTOM LEFT: Cover flown from Amsterdam to B'Wetering, June 21, 1945. TOP CENTER: Sheet of Dr. de Bruijn's 25th anniversary stamps. BOTTOM CENTER: Dr. de Bruijn making a short-wave radio broadcast. TOP RIGHT: Cover flown from Amstelveen to Ouderkerk, June 6, 1945. MIDDLE RIGHT: The "Lightning," one of the largest of Dr. de Bruijn's rockets. BOTTOM RIGHT: Cover flown on Dr. de Bruijn's 25th anniversary, September 16, 1946. ###


NEDERLANDSCHE RUIMTEVAART STUDIO
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AMSTERDAM-ZUID 2
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Z. Amstellaan 136, Amsterdam Z
Edisonstraat 45 Schiedam
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Den Wel.D.heer
A.J.de Bruijn
Amsterdam-Z
Z.Amstellaan 136
ROCKET FLIGHT
GESTART PER
24 JUN. 1945
RAKET
"BRUNO"
AMSTERDAM(Z)
Zuider Amstellaan 136.
16 SEPT. 1921 – 16 SEPT. 1946
25 JAAR PROEFNEMINGEN
VIVA BRUNO
PRESIDENT DER N.R.S.
AMSTERDAM-HOLLAND
DR. A. J. DE BRUIJN-RAKETPIONIER
"BRUNO"
AMSTERDAM(Z)
Zuider Amstellaan 136.
LIGHTNING
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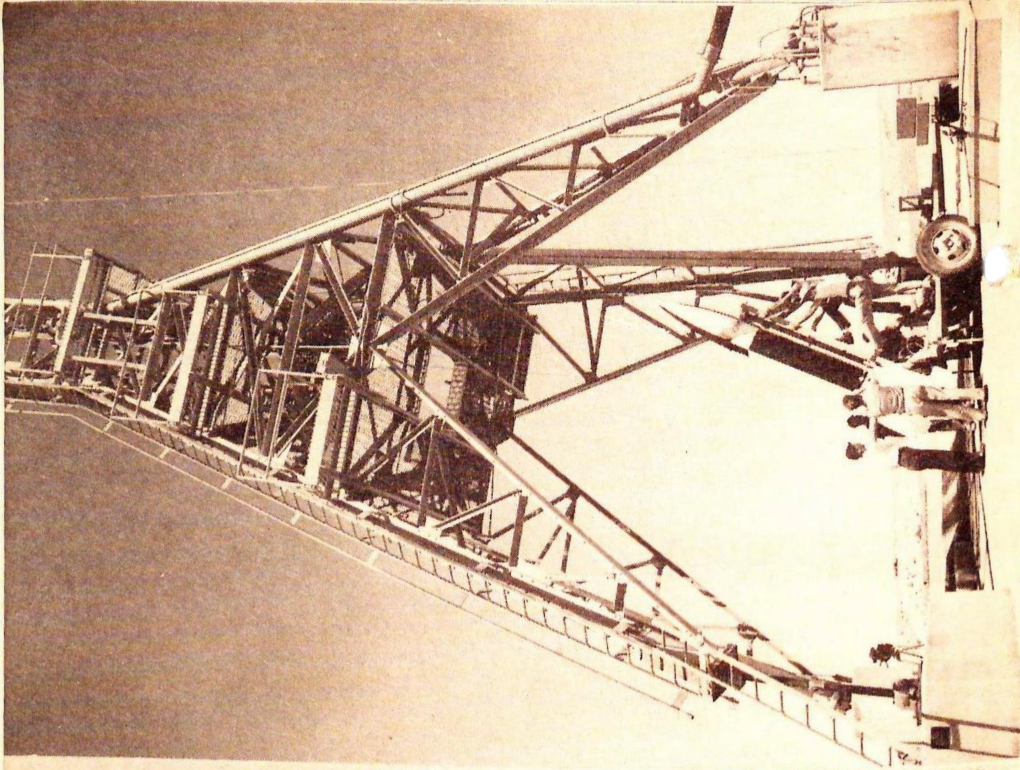

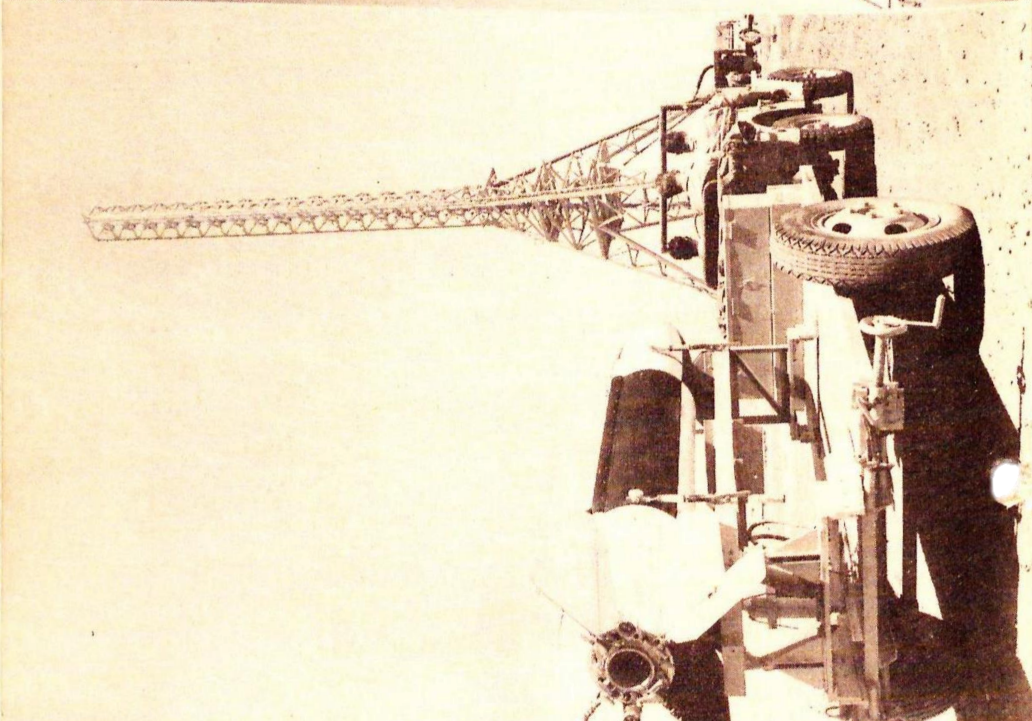

NEW SUPERSONIC ROCKET DEVELOPED

NORTH AMERICAN 'NATIV'

A new test rocket, capable of attaining supersonic speeds and reaching a trajectory altitude of ten miles, was announced early in February, 1949, by North American Aviation, Inc.

The rocket, which was over two years in development, underwent firing tests for six months before any information about it was released by the United States Air Force.

Thirteen feet long, with a diameter of eighteen inches, the new rocket, known as the NATIV, is fired from a specially constructed launching tower, which can be tilted several degrees in any desired direction.

The name NATIV is derived from the initials of the words "North American Test Instrument Vehicle." Official releases did not state how many of the missiles had been built or fired, but said that "several" launchings followed the initial firing last summer.

These pictures are the first to be released showing the North American Test Instrument Vehicle, known as the NATIV rocket, which has been tested at Alamogordo, New Mexico. (BELOW) The NATIV is carried by special trailer to the launching tower, which can be tilted by hydraulic jack screws on each of its four legs. (ABOVE) Handling crews prepare to raise the rocket and place it on its tracks in the firing tower. The launching rails can be seen through the maze of metal work near the top of the picture. Notice the three platforms, arranged so that work can be done on all parts of the rocket simultaneously after it is in position. ###

Tests of the NATIV have been held at the isolated firing range on the Holloman Air Force Base near Alamogordo, New Mexico. All of the firings were termed "successful."

At one time the aerophysics department of North American Aviation had more than ninety employees at Alamogordo working on the NATIV project.

The Alamogordo crew was headed by Tom Moore, in charge of firing and instrumentation for flight data; Loren Sackett, director of propulsion; and S. J. Goldberg, in charge of range instrumentation.

Constructed at North American's Downey, California, plant where the company's rocket and guided missile program is centered, the NATIVs have been used as test vehicles for aerodynamic research.

Data obtained from experimental work with the NATIVs has also contributed to the study of control systems for training rocket launching crews for the Air Force.

The missiles, which were manufactured in the machine departments of North American, were assembled by the Aerophysics Department in Downey. Many of the instruments, radar and telemetering, which were used in the NATIV were also designed and built by the Aerophysics Department.

At the head of the Downey project was Dr. N. E. Edlefsen, associate technical director of the laboratory. Bill Darling was the project engineer at the Downey plant.

The type of fuel used by the NATIV was not revealed in the official releases, which simply announced that the missile was "powered by a liquid fuel rocket motor."

The NATIV looks very much like a scaled-down version of the famous German V-2 (A-4) rocket, their ratios of maximum diameter to total length being almost exactly the same. However, the NATIV has a fairing running along the body from near the nose to the base of one of the fins, very much resembling the WAC Corporal, the famous liquid-fuel rocket developed by the Jet Propulsion Laboratory, GALCIT.*

The moveable guiding vanes are also interesting, in that they extend considerably beyond the edges of the four fins, as may be seen from the photographs. In this respect they are similar to the vanes of the German-built Wasserfall (Cateract) which was developed during the recent war but never put into use.

The launching tower is of considerable interest. From photographs it appears to be about 125 feet high, with four legs, each of which rests on a concrete base.

Each base contains a hydraulic jack screw, so that the tower can be tilted in any direction. The rocket is thus given an initial start on the course desired, instead of rising vertically and then assuming the direction which it is intended to take.

The rocket moves on guide rails within the launching tower during the first few seconds after firing. Surrounding the rocket as it is placed in the tower are three platforms, so that technicians can work on it at all points simultaneously.

The rocket is carried to the launching site on a small trailer which can be towed by a jeep. It rests on a cradle which can be raised to a vertical position by a crank. The number of men

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* 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.

in the crew appears to be small. No mention is made in the report of any provision for salvaging the rocket's instruments after its flight.

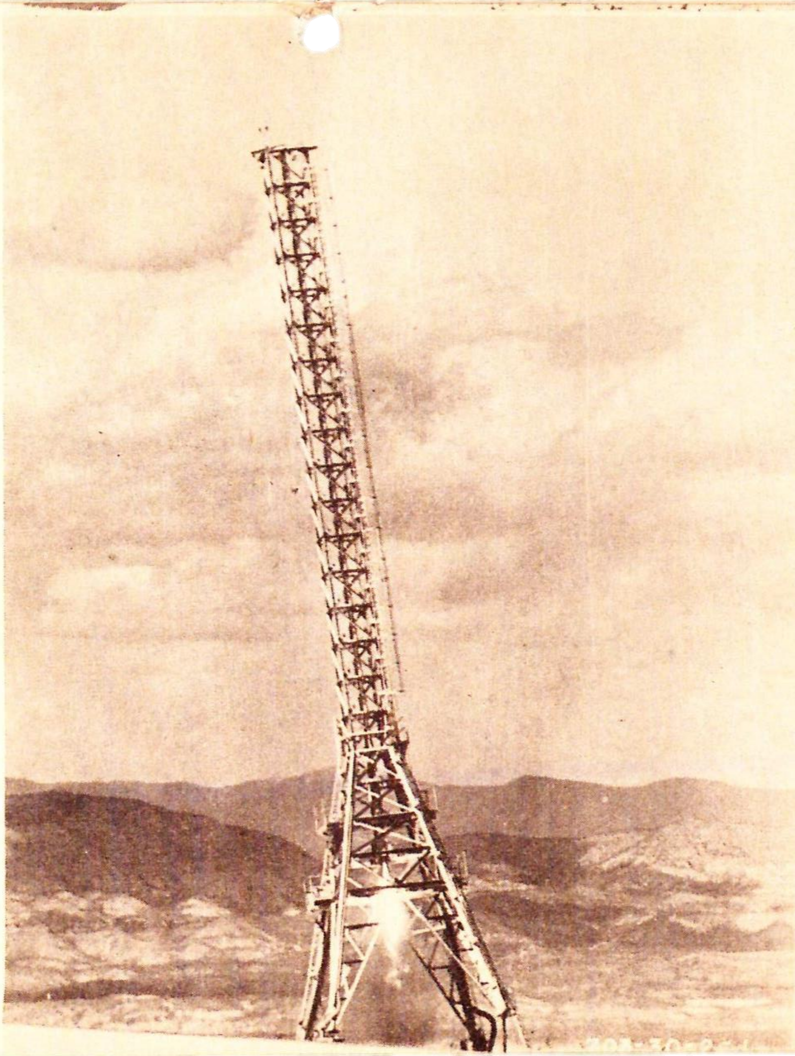
The NATIV is described as having "a long sharp needle-nose." Since this is not apparent in the photographs, it is probable that the actual nose is attached after the rocket is in position for firing, to protect it from damage.

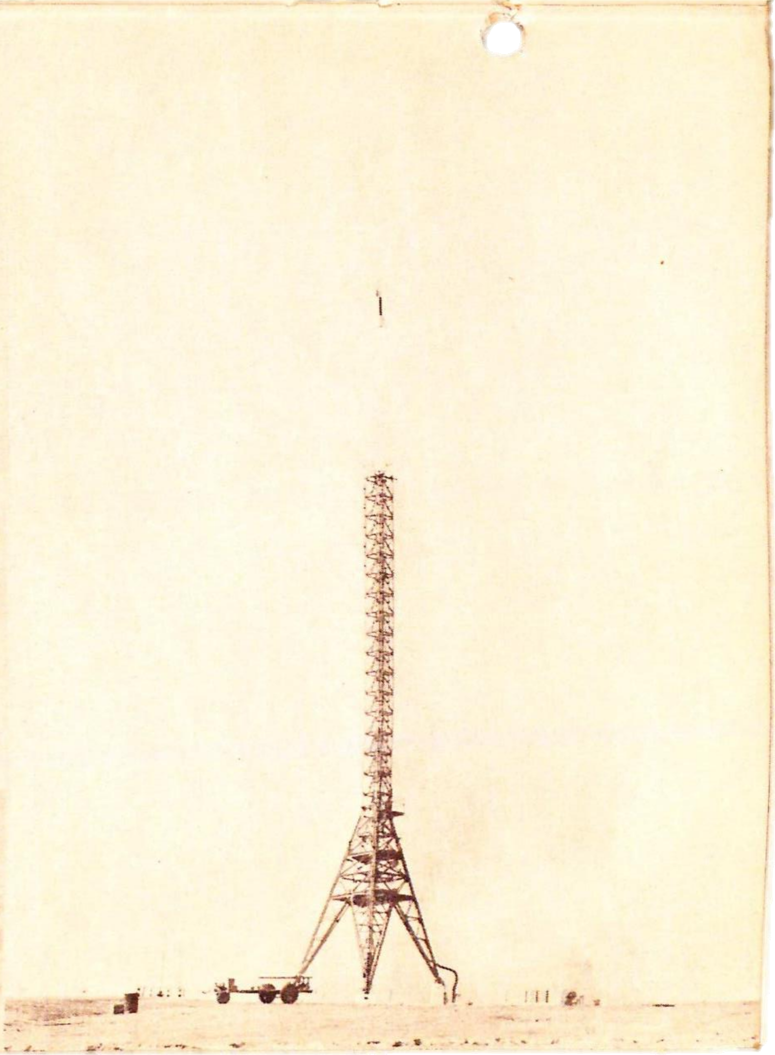
The visible flame from the rocket motor during takeoff is quite long, extending from the rear of the rocket in a brilliant jet almost as long as the missile itself.

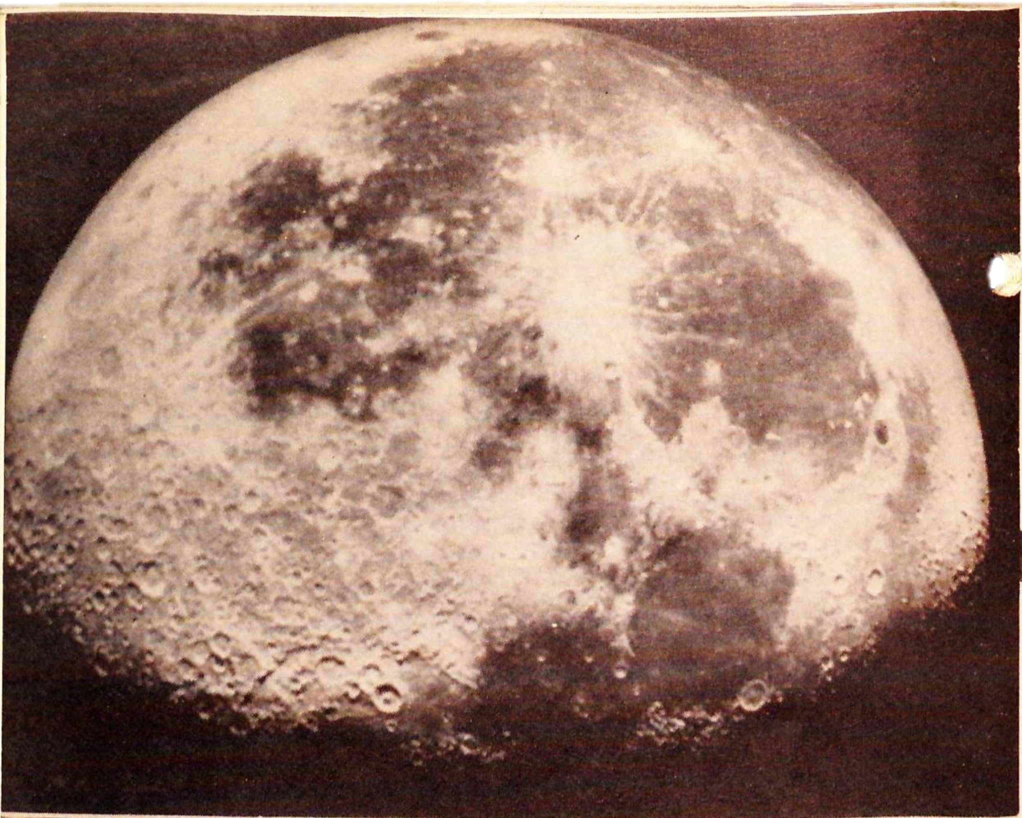
In revealing the Air Force's guided missile program, General Hoyt S. Vandenberg, USAF Chief of Staff, announced at the same time that the NATIV data was released that a program was under way to purchase guided missiles and allied equipment to be used in new training programs for Air Force guided missile launching crews.

President Truman certificated $16,200,000 for the missile program in the fall of 1948. On January 13, 1949, he certificated an additional $10,300,000 for this purpose, bringing the total to $26,500,000 which will now be used in procurement of missiles and allied equipment for operational training and experimentation.

(BELOW) The liquid fuel rocket motor of the NATIV has just been ignited, and the rocket will roar up the rails in the launching tower, which is tilted sharply to the left. (ABOVE) The rocket has just left the launching tower in this picture, which was taken at a different firing than the other photograph. Notice the extreme length of the visible flame in both of the pictures. Announced trajectory altitude of the NATIV was ten miles, and its speed was stated as "supersonic" in information released by the United States Air Force in February, 1949. ###







A ROCKET RESEARCHER PRESENTS A NEW THEORY —

AN ATOMIC WAR KILLED THE MOON

The first rocket to land on the moon may discover that an atomic war fought thousands of years ago by inhabitants of our satellite rendered it the dead world which astronomers know today, according to a theory announced by a researcher after four years of study.

The theory that the moon may once have been populated by intelligent beings who discovered the secret of nuclear fission and destroyed themselves in atomic warfare was developed by Arthur Louis Joquel II, and was presented in a lecture titled "Did An Atomic War Kill The Moon?" at a joint public meeting of FutuREsearch and the Beverly Hills Section of the Reaction Research Society on June 14, 1949.

"The atomic-bomb theory about the moon is not as far-fetched as it might sound," Joquel declared. "The great craters on the moon have been attributed to volcanoes or meteorites, but neither of these can satisfactorily explain some of the features observed on our satellite.

"Some astronomers believe that life exists throughout the solar system. If this were true there is nothing illogical in the theory that the beings who once lived on the Moon discovered

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(TOP LEFT) The region of crater Copernicus, 56 miles in diameter, near the central portion of the Moon. (BOTTOM LEFT) Region of crater Tycho, also 56 miles in diameter, on the southern portion of the Moon. (RIGHT) The whole Moon, age 19 days. These photographs were made at Mt. Wilson Observatory with the 60-inch and 100-inch telescopes. ###

the power of the atom, used it for warfare, and utterly destroyed themselves and their world."

The new theory does not discard the volcanic and meteoric hypotheses concerning the moon, but rather supplements them, according to the researcher. Some of the craters are believed to be scars of fallen meteors, just as such bodies have left giant pits on the earth. And the obviously volcanic craters were probably set into activity by the terrific force of the atomic explosions.

If the moon has an atmosphere so attenuated that at the surface it is only 10^{-4} the density of the atmosphere of the earth, then at an altitude of about 50 miles the density of the two atmospheres would be equal, and above that distance the atmosphere of the moon would be the denser. Since most meteors burn out long before coming that close to the earth, it would seem that the same rule would apply to the moon, and the surface would thus be protected from the "continuous rain of meteoric particles" which some astronomers have postulated.

So many objections can be raised to both the meteoric and volcanic theories of the origin of all the craters on the moon, particularly on the problem of the titanic energies involved, that neither of these can be accepted as entirely satisfactory. However, the forces which are known to be released in the detonation of fissionable material are quite sufficient to blast the great craters which scar the lunar surface.

Since the moon is considerably smaller than the earth, it probably cooled more rapidly than the earth if, as seems probable, they were both formed at the same time. The evolution of life on the moon would therefore have proceeded more rapidly than on earth, and may have reached a stage equivalent to our own ages ago, the theory continues.

"The [illegible] seems incontrovertable that the moon at one time possessed a substantial atmosphere and hydrosphere," said Joquel. "This gives two alternatives; either the atomic war was fought while the atmosphere was still dense, before the low gravity of the moon allowed it to escape into space, or else a chain reaction from the atomic explosions burned it away.

"Whether there is any residual radiation on the lunar surface, such as was present at the atomic bomb tests several years ago, will not be determinable until the first rocket ship reaches the moon," he continued. "However, it has probably all dispersed by this time."

The theory is interesting in that it accepts one of the oldest ideas about the moon's surface as being true—that the large dark areas are old sea bottoms. The occurance of craters in the so-called seas is only a fraction of those which are found on the higher areas which may have been dry land at one time.

The new theory could not have been enunciated with any certainty before the atomic bomb was announced four years ago, it was pointed out, since the knowledge of nuclear energy before that time was extremely uncertain, and the field of atomic physics was based only upon unproven and often disputed hypotheses.

Arthur Louis Joquel II is technical research director of FutuREsearch, an organization of persons interested in the future of mankind and the world, and director of the Beverly Hills Section of the Reaction Research Society. He has been working on the lunar atomic theory ever since the first atomic bombs were dropped. He has sopken on the idea publicly several times in the past, but this lecture was the first complete presentation of the theory.

LONG-RANG[illegible]

TRANSPORT OF 1955

A panel discussion on this subject was a feature of the 1948 Society of Automotive Engineers Aeronautic Meeting, which was held at the Hotel Biltmore, Los Angeles, California, October 6-9, 1948. By permission of the SAE, ASTRO-JET presents here excerpts from four of the papers which deal to some extent with the problem of jet propulsion. The drawing which illustrates Mr. Clarence Johnson's conception of the 1955 transport was done by Nick Stasinos, and the cut was loaned by the Northrop Aeronautical Institute of Hawthorne, California.

The airplane upon which this discussion is based has been described in broad terms as one that will have a cruising range of 3500 miles plus reserve, a cruising speed of 400 mph minimum, and a size of 50 to 100 passengers.

POWERPLANTS? EFFECT OF VARIOUS TYPES

Charles Froesch
Chief Engineer, Eastern Air Lines, Inc.

In this analysis it was assumed an aircraft able to fly 4,000 miles with no fuel reserve and zero wind conditions.

The types of engines which could be used for preliminary analysis were narrowed to three: the compounded reciprocating engine, the turboprop, and the turbojet.

The jet propulsion engines were considered to be of the simple thermodynamic cycle, meaning that in the calculations no consideration was given to possible regeneration, ducted fan arrangement, or tail pipe after-burning.* Only water injection for takeoff was assumed to obtain maximum gross weight for each type of aircraft and the same airport runway length.

Aerodynamically, the turbojet is the most desirable as it permits low drag by the use of small nacelles or buried installations and requires no cooling power. It is also the lightest of the three powerplants discussed.

Disregarding for the moment powerplant installation weight, fuel consumption is obviously the most important engine characteristic affecting range. The compounded reciprocating engine has the lowest specific fuel consumption, and the turbojet, the highest. Balancing this, however, is the fact that the turbojet is best adapted for very high speed and high altitude flying which minimizes this disparity on the basis of miles per pound of fuel consumed.

For the higher powers per engine, both turboprops and turbojets deliver more power per pound of weight and offer a more compact power package than the reciprocating engine. The multiplicity of cylinders in high powered reciprocating engines requires the use of a large number of spark plugs which, in itself, is quite an operational and maintenance item.

This study has also shown that maximum range can be achieved with reciprocating engines, providing cruising speeds do not exceed 350 m.p.h.

Above 500 m.p.h. turbojets are best, and between these two speeds turboprops seem to be most suitable.

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* See "Turbojet Engine Performance Characteristics with Reference to Methods of Augmentation," by Edward Woll, in ASTRO-JET Number 21, Summer, 1948.

WHAT WILL BE THE NUMBER, TYPE AND ARRANGEMENT OF POWERPLANTS?

Harold W. Adams
Chief Design Engineer, Douglas Aircraft Co. Inc.

After concluding that we should have four engines, we must analyze the type and arrangement of engines. We are interested in reliability, light weight in both powerplant and airplane, and reduction of maintenance to a minimum. Since the simplest powerplant practicible at these speeds and ranges appears to be the turbojet, let us examine the turbojet in respect to reliability, weight and performance. Since the turbojet avoids the propellor and gearing of the turboprop engine, it appears that the reliability of the turbojet will always be greater than the turboprop.

Airplanes with turbojet powerplants usually have lower powerplant weights than airplanes designed to do the same job with other types of powerplants. It is possible that a more efficient powerplant may give a lighter weight airplane because of the reduction in fuel, but the other engine always has an uphill battle as compared with the turbojet because of the penalty in propellor weight and the weight required for compounding reciprocating engines, or for applying heat exchangers for turboprop engines.

By 1955 the maintenance of the very simple turbojet engine should be definitely better than competing engines. Therefore, it appears that a detail analysis of reliability, weight and maintenance as well as the overall consideration that the simplest powerplant should be best, would both lead us to decide that the turbojet type powerplant should be used.

Knowing the number and type of powerplants, we must now arrange the powerplant in the airplane. [illegible] that the engine should be as far removed as is practicable from the passengers and from the fuel. Therefore, it is desirable that the engines should not be in the fuselage and that if possible should not be in the wing either. Maintenance requires that the engine should be accessible on all sides, should be readily removable, and should be at a reasonable working level. These requirements seem to point to some sort of suspended nacelle. The suspended nacelle makes for ideal engine intake and outlet conditions, which will result in greater thrust and lower specific fuel consumptions than either of the other arrangements.

WHAT ARE THE DEPARTURES FROM CONVENTIONAL ARRANGEMENTS TO GET THE REQUIRED PERFORMANCE?

A. J. Fokker
Consolidated Vultee Aircraft Corporation

The idealistic goal of air transportation is to provide such speeds so that no one, no matter what the distance, has to sit down longer than you or I would like to do in comfort.

Speed and safety are the only commodities the aircraft industry is selling and is what the passenger purchases.

Discussion of a 400 m.p.h. airplane looks to me as though we are discussing a 1950 version. We might as well take the next step and look at an airplane with a speed of 500 m.p.h. and above for 1955.

Departures from conventional arrangements to get required performance is an extremely broad subject. In general we can say:

(1) Wing:

Planform—it looks like a conventional modern wing will do the job as the speeds involved do not justify tricks like delta wings or swept-back wings.

(2) Fuselage:

Passengers still will have to be accomodated in an enclosure, and we have seen the wing thickness decrease to a point where it is inadequate to house them. So we will be stuck with a fuselage of the more or less conventional design but cleaned up to the extreme as to minimize its drag. Antennas, astrodomes, and all protuberances, will have to disappear.

(3) Powerplants:

Turbojet or turbopropellor powerplants seem to be the logical solution from what we know of them today, however, whether we will be able to reach the size and capacity is just another guess. Fuel consumption will have to be lowered considerably to keep the size of the subject airplane in hand.

(4) Landing Gear:

Conventional tricycle landing gears in general are harder and harder to tuck away, especially with the thinner wings and modern powerplants, and it can be readily visualized that the time has possibly come to house them again in the fuselage. It is possible that we have to go to a bicycle gear which seems to work satisfactorily.

WHAT DOES THE 1955 TRANSPORT LOOK LIKE?

Clarence L. Johnson
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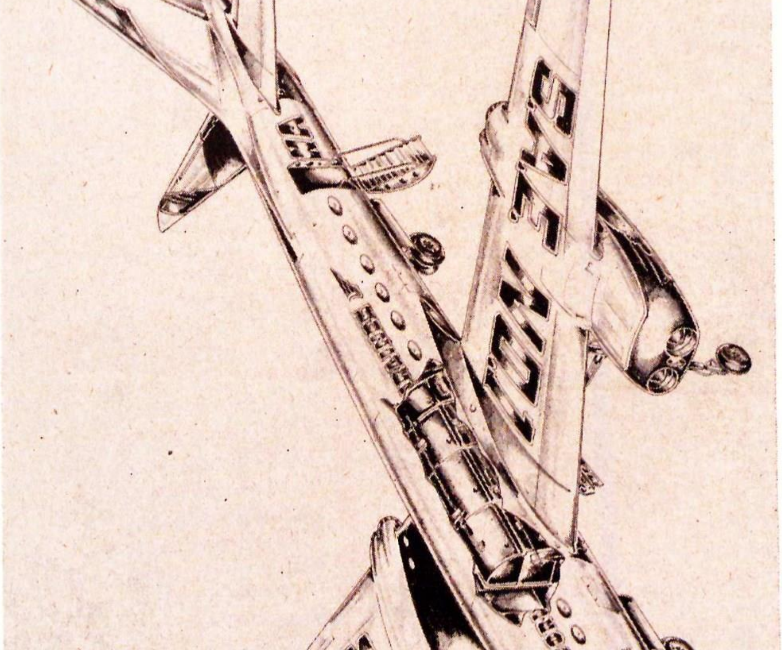
It is necessary for me to change the title of my paper to "What Should and Can the 1955 Transport Be Like?" if I am to present my firm personal convictions on the subject.



A few of the reasons for choosing the jet engine over the double compound reciprocating type or the propellor-turbine type are shown below:

1. A transport airplane introduced in 1955 must last at least ten years in service due to economic reasons based on present experience. I do not believe that in 1960 to 1965 we will accept propellor type propulsion as we know it today, with its attendant complexity, noise, weight, and roughness. Airlines will therefore be very hesitant about making short-sighted equipment investments.

2. In 1945, the overhaul time on a P-80 engine was ten hours. Today, three years later, it is 250 to 300 hours. By 1955 jet engine overhaul time should be 700 to 1000 hours. Overhaul cost is about 35% to 40% of a reciprocating engine. The miles traveled per overhaul will be 25% more, so the engine cost per mile is greatly reduced for the jet engine.

3. Propellor problems on existing transports have required changes in service costing millions of dollars in the last few years. On new transports with higher speeds, wing loadings and powers, the existing problems will be increased from 300% to 500%.

4. Based on known propellor problems, it seems that propellor weight for the gas turbine powerplant will approach the weight of the engine itself. The complexity of propellor control problems on turbine engines opens up a whole new field of gadgetry which will dismay the operators no end.

5. The present jet engine is very elementary in its conception. Improvements (which are already known) in materials will reduce fuel consumption and increase power substantially.

6. When comparing propellor driven aircraft to jet types, the latter is seldom given

sufficient credit f[illegible] overall drag which goes far to [illegible] the higher fuel consumption of the engine itself.

If we really want it, here is the kind of an airplane that can be built within the stated time period if the manufacturers and the Government sign the order blank to the engine and airplane designers:

Gross weight: 150,000 lbs.
Number of passengers: 40 to 50
Number of crew: 3
Cruising altitude: 37,500 feet
Cruising speed: 530 m.p.h. at 37,500 feet
585 m.p.h. at sea level
Range: 3500 miles against 60 m.p.h. headwind plus 45 minute reserve at 15,000 feet
Ride qualities: Comparable in rough air to present 4 engine transports but much smoother and quieter from engine effects
Field length, one engine out:

Sea level, standard day	6500 feet
80 degree day	7500 feet

The airplane shown is predicated on knowledge we have now and based on engines which will be available within three years for experimental flight. With four more years for development, it is evident that sufficient reliability would be obtained and probably the performance shown considerably improved.

Considering the engine improvements which will surely develop in the period 1955 to 1965, the potential improvement in the jet transport operating economy makes inevitable the choice of that type over those with external propellors.

We can have the type of airplane described if we want it. To get it by 1955 we must start next year. Why not start now? ###