ASTRONAUTICS

Journal of the American Rocket Society

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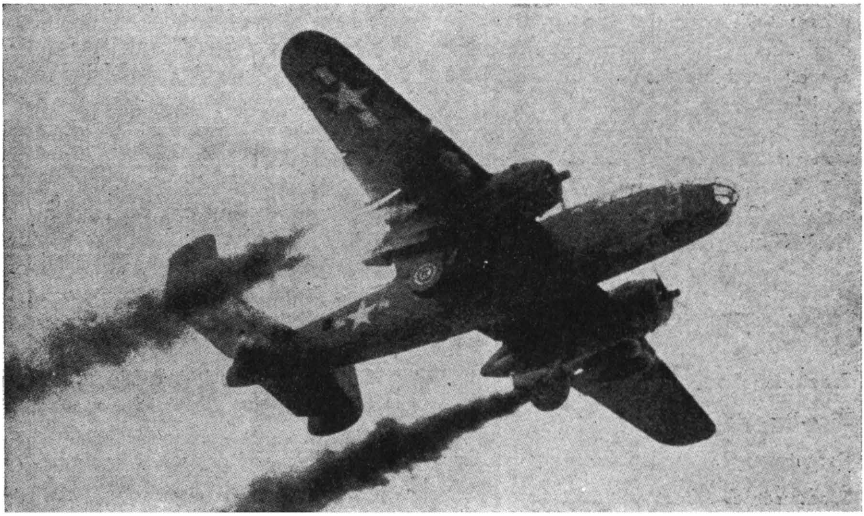


—AAF Materiel Command

JATO—A B-25 medium bomber equipped with jet assisted takeoff units. The jet units, affixed to the fuselage of a plane, contain a solid propellant which is ignited by electrically-controlled spark plugs. By using jet units the takeoff run of planes can be reduced as much as 60 percent.

THE AMERICAN ROCKET SOCIETY

was founded to aid in the scientific and engineering development of jet propulsion and its application to communication and transportation. Three types of membership are offered: **Active**, for experimenters and others with suitable training; **Associate**, for those wishing to aid in research and publication of results, and **Junior**, for High School Students and others under 18. For information regarding membership, write to the Secretary, American Rocket Society, 130 West 42nd Street, New York City.

NOTES AND NEWS

A brief history of the existing British rocket societies was recently printed in Spacewards, official organ of the amalgamated British groups.

The Combined British Astronautical Societies is formed from the Astronautical Development Society and the Manchester Astronautical Association and the various local groups of these two organizations. The M. A. A. was inaugurated in December 1937 by E Burgess and T. Cusack, and in 1938, following the policy of its constitution, affiliation was completed with the Paisley Rocketeers Society and later with the British Interplanetary Society. A journal, Spacewards, was issued in 1939. With the war, the P. R. S. and the B. I. S. ceased activities for the duration and the M. A. A. continued alone until contact was made with the A. D. S. in December 1941.

The Astronautical Development Society was founded in 1938 by K. W. Gatland and H. N. Pantlin, and a journal, Spacecraft, was issued. In January 1942 the two organizations commenced working together. In March their bulletins were combined and in October 1942, Spacewards became the combined journal of the two societies. Meetings were arranged during 1943, between representatives of the two committees and the result of these meetings was complete agreement, and finally at the beginning of 1944, the C. B. A. S. was formed with the objects of coordinating all research in the British Isles, and bringing about that necessary cooperation which has been the aim of all British societies during the last decade.

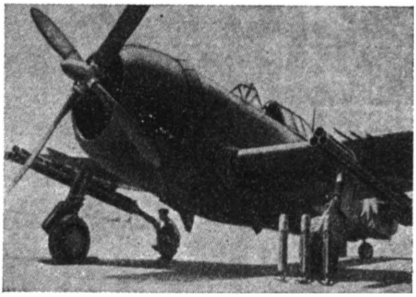
Airborne Rocket Projectiles

FIGHTER PLANES USING JET-PROPELLED MISSILES

Rocket launchers have been supplementing the firepower of machine guns and other armament on U. S. fighter and dive bomber planes in the China-Burma-India, Pacific and other theatres of war since early this year. These "flying bazookas" have been most effective against all kinds of land, sea and air targets in combat areas, even successfully attacking heavily armed German U-boats. The weapon has the advantage of possessing a high explosive charge with little of the troublesome recoil of large guns, as the propelling force is dissipated in the air.

Experiments on rocket launching devices were conducted at Wright Field and Aberdeen Proving Grounds as long ago as 1942. In the initial experiments single heavy steel tubes tied under the wings of a Curtiss P-40 were used to launch the projectiles. The early tests were extremely hazardous due to the ever-present danger of the rocket blast setting fire to the plane. Successive tests with improved designs eventually eliminated the majority of faults in the unit.

The rocket projectile now in use is about 3 feet long and 4½ inches in diameter. The one foot warhead section of the projectile contains a high explosive which can be either exploded by a fuze on impact or set off at a prearranged time while in flight. Aft of the HE is the compressed propulsive charge which on igniting is generated into a highly compressed gas. The impulse of the gas passing through the 1½ inch diameter nozzle drives the rocket forward at high speed. During flight the rocket is stabilized by six



Rocket Tubes on P-47 Thunderbolt Being Loaded

small tail fins acting against the air to provide rotation. The fins are hinged in such a manner that they can be folded up when the projectile is being loaded into the launching tube.

The airborne launching unit consists of a cluster of three long tubes suspended under each wing of the plane. The tubes, made of a special light-weight paper plastic developed by General Electric engineers, are 10 feet long, 4½ inches in diameter, and have a ¼ inch wall thickness. The rocket installations weigh approximately 450 lbs. and are so constructed that any fighter plane can carry them. Each of the six launching tubes carries one projectile which is loaded when the plane is grounded. Aiming of the tubes is accomplished by employing the same sight as for the ordinary guns. The six rockets may be discharged individually or in rapid succession by the pilot operating an electric switch on the control stick.

The pilot is also able to drop the rocket projectiles as bombs on a target.

The V-1 Robot Bomb

DETAILS OF THE GERMAN AIR TORPEDO

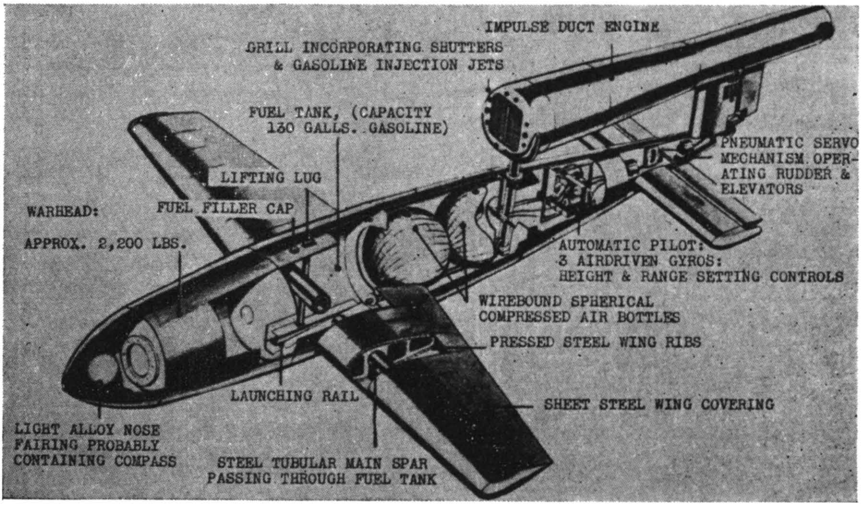
By Cedric Giles

The aerial torpedo is known officially by the British Air Ministry as P. A./c (Pilotless Aircraft), as V-1 (Vergeltungswaffe Ein) by the German officials, and everything from "doodle bug to buzz bomb" by the British public. Types now in use have wing spans up to 30 feet and speeds ranging to 400 mph with the most common form having the following dimensions: wing span 16 feet, fuselage length 21 feet 10 inches with maximum width 2 feet 8¼ inches, and overall length 25 feet 4½ inches.

This version is an all-metal two ton monoplane having wings set in mid-position with almost straight leading edge and tapered trailing edge to square tips, tail rudder and elevators, but no ailerons. Fuselage is circular in section tapering at the stern and having no undercarriage, with the long propulsion unit mounted over the tail section. Pressed steel wing ribs are attached to a tubular spar which passes through the fuel tank and extends to the wing tips. The entire wing assembly is covered with sheet steel. High wing loading is between 80 and 100 lbs. per sq. ft.

The fuselage of the winged bomb is bulkheaded into six sections. The light metal nose fairing probably contains a compass which may act on the rudder to compensate for wind drift. Directly behind the nose section is the warhead which holds a ton of high explosive which explodes on contact. A fuel tank with a capacity of 130 gallons of gasoline is placed between the wings. Aft of the fuel tank are two spherical wire-wound compressed air bottles for providing pressure to regulate and pump the fuel, and drive the three pneumatic gyroscopes and automatic height and range setting controls housed in the following compartment. The tail section contains the pneumatic servo mechanism for operating the rudder and elevators.

The 11 foot tubular intermittent jet engine is of a simple design. Supported at the forward end by a strut through which passes the fuel lines and control leads the welded steel propulsion unit is sustained farther aft by the fin of the pilotless plane. The firing cycle consists of atmospheric air entering the forward end of the tube through a square filter screen embodying a system of multiple unbalanced shutters normally held closed by spring leaves. The ram effect of the external air due to the forward motion of the propulsion duct forces open the spring shutters left closed by the preceding explosion. Air from the compressed air bottles injects the correct quantity of fuel through nine fine jets into the moving air stream in the unit to form an explosive mixture. Fuel feed is in most cases continuous but fluctuates to meet changes of forward speed and altitude. The mixture is ignited by incandescent bars heated by the previous charge, tho for starting a single spark plug is installed in the Venturi tube. The resultant explosion creates a large volume of gas which closes the intake shutters and exhausts through the long rearward propulsion



—London Daily Express

Diagram of the Nazi Robot Bomb

nozzle giving a forward thrust to the air torpedo. As the internal combustion pressure drops atmospheric air again forces open the intake flaps with a repetition of the operating cycle estimated at 40 times per second.

The air torpedo is launched from a concrete platform by catapult or other device along a ramp about 200 feet long and 3 feet wide rising gradually at an angle of approximately seven degrees.

Control during flight is accomplished by the automatic pilot set before takeoff. Not being radio directed all ground control is lost after launching. The automatic pilot gyros hold the air torpedo on a straight level course and correct any deviation. Flying at a height of approximately only 2000 feet makes it difficult to detect by radio locators. The flying speed of early bombs gradually cut from over 300 to about 200 mph apparently due to the pressure decrease in the air bottles as the compressed air was used. Recent models maintain a more constant speed throughout flight. Puffs of bluish-white exhaust smoke are visible during daytime and six foot orange-red flames at night. The maximum range is about 150 miles which the robot covers in 20-30 minutes. As the target is neared the jet engine is cut automatically or fails from lack of fuel and the air torpedo either glides or through operation of a clocking device swerves in a quick turn as it dives at the ground.

A small percentage of the robot bombs carry a miniature radio transmitter with a trailing aerial which sends out signals at a 10 second frequency during flight or a radio signal as the robot lands as an aid to the launching base in determining the automatic pilot settings on following bombs. Cost of the air torpedo has been estimated between $500 and $4,000 per unit depending on the type of flying bomb, scale of production and ability in procuring materials.

Rocket Experiments In Manchester

PRE-WAR RESEARCH BY AMATEUR GROUP

By E. Burgess

Ten years ago, in 1934, the first experiments to be made by the Manchester group of rocket enthusiasts were conducted by the writer, before the formation of the Manchester Interplanetary Society. Although these tests were not of very great scientific importance, from them was gained a great amount of practical experience of the laws of rocket motion. Primarily, this work consisted of the taking of normal commercial powder rocket tubes, and attempting to improve them by reducing the weight of the container, and by adding special nozzles. Whilst some of the more ardent astronautical workers may have deprecated such practice, it is only fair to point out that it was quite common for most of the experimenters of those days to employ commercial rockets in their tests. The main faults of these professionally constructed rockets were not in the powders, but rather in the manner in which the powder was burned and the efficiency with which the chemical energy in the fuel was changed to kinetic energy in the efflux jet. The conventional stick-like guiding tail was also far from the ideal method of ensuring a steady and pre-determined trajectory.

The Manchester experiments also included a series of tests with various types of launching apparatus and methods of stabilizing the rocket in flight. A "Flyingwing" type of aircraft model was also flown with some success in 1935.

With his formation of the Manchester Interplanetary Society in June 1936, the writer directed the Research Programme of the Society until December 1937 when he became president of the newly founded Manchester Astronautical Association. During the period when he was president of the M. I. S. the research was continued and several new ideas were tested in the 1936 programme. The work can be separated into two definite stages, the first being from June to December 1936 when commercial powder rockets were used, and the second from December 1936 onwards, where the Society made their own rocket tubes.

Step Rockets

In the first stage, the walls of the rocket tubes were considerably lightened by making them much thinner, and long nozzles were added to some models. The stability of the rockets was assured by various systems, chief of which was the centrifugal fin idea, one which was most successful when the fin also acted as an air injector. During this period, also, there was launched what was possibly the first two-step rocket to be tested in this country. The world had been talking of employing the three-step rocket as a means of conquering interplanetary space, but the M. I. S. were testing the idea practically and successfully. With reference to Figure I, the first step comprised seven powder rocket tubes arranged in a cellular construction and fused so as to be ignited in the order—'four, three'. At the end of burning of the central tube, it was arranged to ignite a fuse which was timed so as to fire the second step at the end of the propulsive period of the first step; that is when the velocity of step number one was at a maximum. On afterthought, it appears that a greater height would have been obtained if the ejection of the second step had been longer delayed. The main point of this type of rocket is that the smaller rocket commences its flight at a high velocity and, hence, at a maximum propulsive efficiency. Stability of the model was achieved partly by rotation and partly by the use of fins. The second step depended upon the angular momentum it had on ejection and also upon two short stick-like fins.

When this model was fired at the second M. I. S. research meeting on December 12, 1936, it proved quite successful. The first step was seen to reach a height of 150 to 200 ft., before "staggering as from a blow" as the second step was ejected. The velocity of this second step became so great as to render observation of its trajectory impossible, and it was not recovered after the experiments.

At the same meeting a multiple launching device, for small rockets, was tested, and looking back over the years, it appears as though an apparatus which had little practical value during those days of peace has now found deadly application as a weapon of war.

Guiding systems were evolved from the simple fins of Figure II, to the centrifugal fin of Figure III and the injector centrifugal fin system of Figure IV. These systems, unfortunately fell short of the research committee's requirements, due to the fact that if a strong wind was blowing, the rocket invariably turned into the wind. This unfortunate defect must always occur when a rocket has large areas of fin surface below the center of thrust and can only be obviated by having an equal surface area above and below this center. Rotation will not prevent the fault unless the angular velocity is high.

Fuel Developments

During the second period from December 1936 to March 1937, the Society proceeded to experiment with fuels and the construction of rocket tubes, and no fewer than five hundred tests were made. All these tests, of course, were not of free rockets, but those free rockets that were tested, proved highly satisfactory. The largest of the rockets contained approximately two pounds of fuel and heights of about 2,000 ft. and distances of up to half-a-mile were achieved. Many of these rockets were launched from a copper launching tube, whilst others started their flight from the conventional two-rail launching rack that had been employed since the earliest experiments. Fuels were developments of gunpowder with various substitutes for the active chemicals. Different sizes of nozzles were tested and also several methods of loading and compressing the propellants. Cellular constructions became the rule on the larger models, which usually consisted of a large central tube, surrounded by a cluster of smaller tubes for starting purposes, and to give maximum acceleration so that the propulsive efficiency would be high (Figure V).

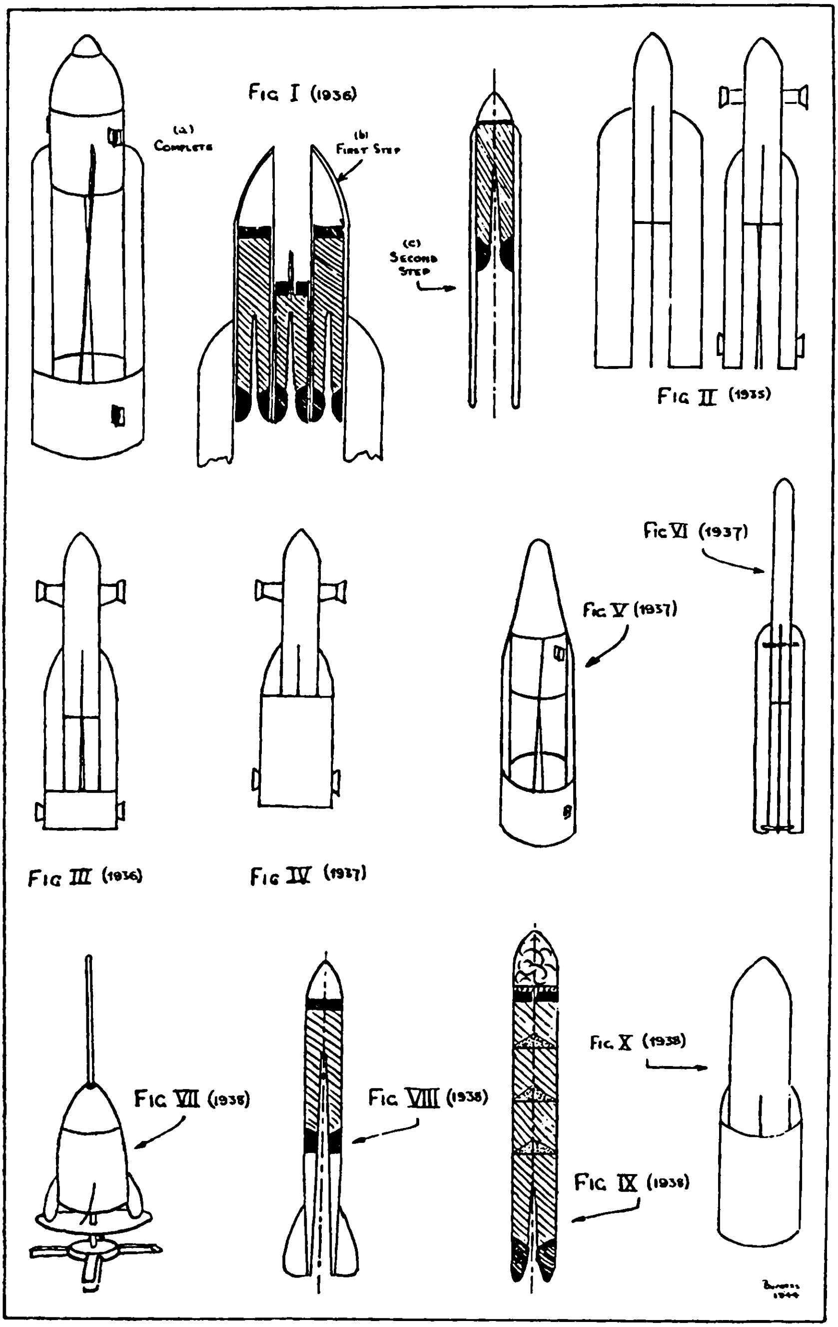


Fig I (1936)
(a) Complete
(b) First Step
(c) Second Step
Fig II (1935)
Fig VI (1937)
Fig V (1937)
Fig III (1936)
Fig IV (1937)
Fig VII (1938)
Fig VIII (1938)
Fig X (1938)
Fig IX (1938)

Research Difficulties

The Research Meeting convened on the 27th of March, 1937, was an unfortunate failure like most of the public rocket tests of those days. It seemed as though all rocket workers were doomed to the same fate, that of producing good results in private and woeful failures in public. One has only to remember Herr Zucker and the Isle of Wight tests, the Greenwood Lake, N. J. stamp plane experiments and many others, to appreciate the disappointments that became the lot of most workers in the new line of experiment. Coupled with the failure of the tests, there was also, quite often, trouble with officialdom and ridicule of the contemporary press. Truly, one had to believe and have faith in one's ideals to continue with the work, and many workers fell by the wayside, or retired into a shell of reticence regarding their investigations. At the research meeting matters went badly for the M. I. S., and the misfortunes culminated in the explosion of a duralumin rocket model (Figure VI). Afterwards, the remaining models, which had not been launched, were dismantled and the tubes used in new designs.

Launching Rack Obstacles

The failure of some of the tests was due to failure of the launching device. Adjustment of the launching guide rails was rather critical and it was made by means of the supporting wires. Due to an unruly crowd which collected and would not retire from the launching racks the adjustments were not correctly carried out. The consequence was that the rockets expended most of their power in attempting to free themselves from the launching racks. "Scaling-up" errors in the fins also caused trouble, and, for the first time difficulties arose with the cellular system. These were because one of the tubes, if it became defective, was capable of destroying the whole of the propulsive system, or of so damaging the system of stabilizing fins, as to cause the rocket to crash to earth.

However, a great deal of practical knowledge was gained from these failures, and the writer designed another method of launching and stabilizing which would overcome the faults of the previous models (Figure VII). Thanks must be expressed here for the guidance, which was given to the writer during this six months period of work, by a pyrotechnical expert, who preferred to remain anonymous at the time.

Pre-Rotating Model

One rocket, which was designed to eliminate the failures of the March meeting, is shown in Figure VII. Here the fins were extremely short and slightly inclined, so as to impart rotation to the rocket when in flight. Cellular construction was employed, and a central launching sleeve was built into the rocket. This sleeve enabled the rocket to be placed over a smooth brass rod which was approximately three feet long, and up which it could easily move when launched. Thereby, the cumbersome rail launching system was eliminated. This rod was attached to a turntable, on which the rocket rested, so that it could be rapidly rotated prior to launching. Stability was thus created by the rotation, and was effective from the very moment the rocket left the launching spindle. The spindle could be inclined at various angles to the horizontal in order to launch the rocket on other than zenithal trajectories if required.

When tested, this type of rocket and launching device proved quite successful.

Varied Designs Tested

Yet another type that was tested with varying success, was one that was fired from a tube type launching rack, and having an extremely long nozzle (Figure VIII). The main purpose of the design was to prevent the rocket from turning into the wind.

Figure IX shows another type that was tested by the M. A. A., it being a development of a German idea which the president had obtained from M. Esnault-Pelterie. Explosions were prevented from disrupting the whole of the fuel, by employing layers of felt to isolate the main powder compartment from the burning section. Tests did not prove unsuccessful, but the idea was not further developed due to financial reasons.

An extremely light, air injector type rocket was successfully tested in the autumn of 1938 (Figure X). This employed a commercial powder tube, an air injector which acted as a stabilizer, and it was launched from a short tube. Acceleration was very great, and the trajectory was quite even. Only one test was made, however, it being all that was required to prove the theoretical point under discussion.

Rocket Plane Design

Theoretical work continued and culminated in the design of the rocket plane in 1939-40, by the late Trevor Cusack and the writer. This plane employed a rotary powder fuel rocket motor supplemented by air injection for greater propulsive efficiency. Although a small-scale flying model was constructed, the wartime restrictions made it impossible to test it in free flight. The preliminary design for the liquid-fuel sounding rocket capable of ascending to 40,000 feet was completed by the end of 1940.

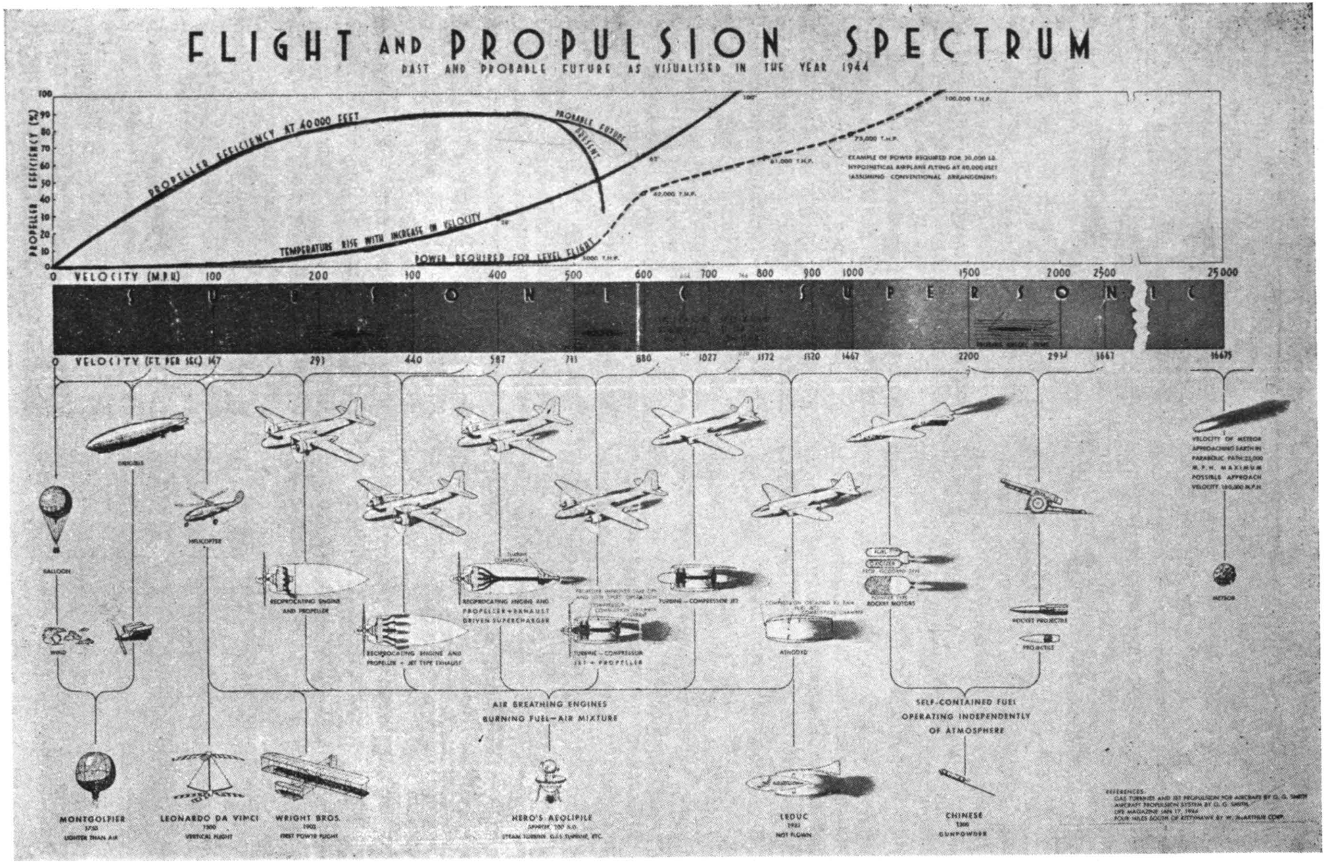
The progress and length of the war restricted other than more complex theoretical investigations, and although a testmotor for the sounding rocket was partially completed, it now appears that the results of these investigations cannot be applied until the cessation of hostilities makes it possible for practical work to be resumed.

(The Manchester Astronautical Association, 2 Hillview Road, Denton, Manchester, is the northern headquarters of the Combined British Astronautical Societies.)

ROCKET RESEARCH

Mr. Constantin P. Lent recently informed ASTRONAUTICS that his book "Rocket Research" is in the process of being printed. The Society has long realized the growing need for an instructive book containing all essential information in the field of rocketry, and has had many proposals on the subject. About a year ago Mr. Lent, then vice-president, was authorized to write a handbook that would prove valuable to technical and semi-technical persons and stimulate interest in the Society, as an authoritative organization encouraging the development of jet propulsion devices.

The book, which will be available shortly, is to contain the most important material published the past years in ASTRONAUTICS, be illustrated throughout with many photographs and drawings, and give numerous tables, formulas and references. A large selection of new drawings showing different aspects of the rocket problem is to be included.



A Pictorial Presentation of Flight and Propulsion by the Douglas Aircraft Company

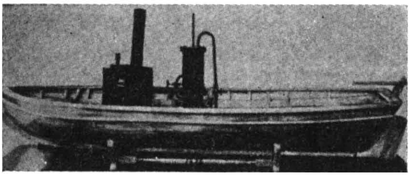
AMERICAN ROCKET PIONEERS

No. 2 - - - James Rumsey

The pioneer in steam navigation, James Rumsey, successfully tested hydraulic jet-propelled boats twenty years before Fulton's Clermont. Born of Welsh descendants at Bohemia Manor, Cecil County, Maryland in March 1743, he acquired only an elementary education before becoming a skilled mechanic and blacksmith. Following the Revolutionary War Rumsey lived at Bath (now Berkeley Springs) Virginia where he first became interested in the problems of navigation and designed a mechanical boat to go upstream. A model of the stream boat was shown to George Washington who mentioned it in his diary on September 6, 1784, and presented Rumsey with a certificate attesting to the incident.

Rumsey kept a small boat at Shepherdstown, West Virginia where he spent his spare time in designing a steam plant, originally consisting of an iron boiler with a lid. After many improvements on the boiler, a trial run was made in the September of 86 with the boat moving at a two mile an hour speed propelled by ejecting a stream of water at the stern.

In a public exhibition on December 3, 1787 the hydraulic jet-propelled craft went up and down the Potomac for two hours at about 3 m.p.h. before a large audience at Shepherdstown. Certificates acknowledging the successful trials were obtained from such prominent persons as Rev. Robert Stubbs, Major-General Horatio Gates of the Continental Army and others. A second public trial on December 11th saw the jet-driven boat, while burdened with three tons, work at 4 miles an hour against the current.



Model of Rumsey's Steamboat

A description of the "flying boat" was published a month later in a pamphlet entitled "A Plan wherein the Power of Steam is Fully Shewn." The hydraulic jet apparatus consisted mainly of a steam boiler, two connected pistons contained in two vertical 2½ foot cylinders and a 36 foot trunk in place of the keelson. As steam from the boiler reciprocally operated the upper piston, the lower piston on its upward stroke drew water through a pipe from under the boat and on its down stroke forced the water through the long trunk and out the stern giving a reaction.

A long drawn out controversy developed between Rumsey and John Fitch, a native of Connecticut, on the priority of propelling vessels by steam power. Adherents of Rumsey formed the Rumseyan Society which later sent him to England to conduct experiments on steam propelled vessels. While delivering a lecture on hydrostatics, he became suddenly ill and died the following day, December 21, 1792.

In his later years, Rumsey was granted a number of patents by the British and American patent offices on steam boat improvements, including the propelling of vessels by hydraulic jet systems. To perpetuate the memory of James Rumsey, the Rumseyan Society had erected a stately monument which overlooks the Potomac at the site of his experiments.

LETTERS TO THE EDITOR

A communication from Mr. J. A. Georges, president of the Australian Rocket Society, mentions that further rocket research is at present impossible as he has joined the Australian Air Force. Mr. Georges enclosed a sketch of a jet-propelled future air and land vehicle and comments as follows on the future of rocketry:

"Its development will expand, I think, along three main branches; commercial, military and scientific. The commercial expansion of the rocket is the one that is likely to receive the most support, for reasons that are obvious. Giant air liners capable of carrying hundreds of passengers and tons of freight at a time, will ascend into the stratosphere and cross from one continent to another in a matter of hours. Next will come the exploration of the Solar System, and the evolution of the space-going freighter, jetting its way to the outermost ends of the System. Most likely a "Jet-car", a combination of road and air vehicle, and equally at home in either element, will be adapted for private and family use.

"The war rocket will supersede all the modern percussion weapons of today. Tho, of course, for the immediate future the most convenient small cannon type such as the quick-firing field-piece will be manufactured. I can imagine nothing more deadly or destructive than a trench mortar firing rocket shells of a tremendous penetrating power. Another phase of super-speed, armour-piercing rocket projectiles can be expected in aerial warfare, in the shape of rocket bombs.

"In the branch of science I can envisage making practical use of rockets to obtain information that is now gathered by means of meteorological balloons. The rocket can carry with it all necessary equipment, and by means of a timing device a small rotor will be pressed into service, so that the rocket can be made to hover at any required height. If dispatched into the realm of space, rockets could do inestimable service in recording the performance of cosmic rays and other phenomena of space and could be controlled by remote-radio.

"These are only a few of the uses to which the rocket can be put to. It is essentially a versatile form of propulsion, and one that is bound to play a great part in tomorrow's civilization."

Some interesting suggestions on a prospective postwar program for the Society have been forwarded by Mr. Richard Hartley Willis, of Champaign, Illinois.

"Every sincere rocket enthusiast is looking forward to the new era of peacetime rocket experimentation that the conclusion of the present war will undoubtedly herald. With the return of peace, research workers will again have time and the access to materials that will enable them to continue their work on space travel which they suspended with the outbreak of hostilities. It is necessary that a workable program be developed which can be put into effect as opportunity permits.

"It is evident that the first step of a postwar program would be the launching of a large-scale "publicity campaign". Informative articles by Society members, plugging rocketry and the Society, appearing in reputable popular magazines would be one of the most satisfactory methods of reaching the public. Radio and motion pictures present two daring and powerful advertising agencies which cannot be overlooked. Publicity by means of newsreels would be extremely vivid and would have the added advantage of a particularly large coverage.

"The prospect for the meteorological rocket is very promising. If sufficiently developed, meaning being capable of consistently achieving altitudes of 100,000 feet or more at a moderate cost, it would render an extremely useful service. It is entirely possible that a sum as small as $60,000 would see the development of such a rocket to completion.

"If the Society's research were directed in this direction and proved successful, it would provide sufficient capital to enable a permanent and systematic research program to be established. In this manner, the Society could be equipped with a large testing field complete with modern machine shop. Experts on rocketry and related subjects could be engaged to devote their entire time to experimentation—all would collaborate in the realization of interplanetary travel. As a result the Society would become the world's leading rocket experimentation group, and as such it would be the appropriate location for an institution designed to keep the world's rocket societies informed of activities and to offer information and technical advice to anyone requesting this service."

UNITED STATES ROCKET PATENTS

In this third list (other lists appearing in ASTRONAUTICS Nos. 53 and 54) are the majority of early rocket patents. Although many of these patents pertain to pyrotechnic, signal, or life-saving rockets they are included owing to the interesting and unique ideas presented in design and text. From time to time other interesting patents not previously reported in ASTRONAUTICS will be listed.

"Improvement in Exhibition-Rocket", No. 24,468; granted to Andrew Lanergan, of Boston, Mass.

"Improvement in War-Rockets", No. 35,977; granted to Thomas W. Roys and Gustavus A. Lilliendahl, of New York, N. Y.

"Improvement in War-Rockets", No. 37,940; granted to Pascal Plant, of Washington, D.C.

"Improvement in War-Rockets", No. 40,041; granted to J. Burrows Hyde, of Newark, N. J.

"Improvement in Rockets", No. 41,689; granted to Isaac Edge, of Jersey City, N. J.

"Improvement in Sky-Rockets", No. 51,176; granted to John W. Hadfield, of Newtown, N. Y.

"Improvement in Rockets", No. 53,933; granted to William Hale, of London, England.

"Improvement in Rockets", No. 58,646; granted to E. S. Hunt, of Weymouth, Mass.

"Improvement in Rocket-Signal Device", No. 79,963; granted to Jacob J. Detwiller, of Greenville, N. J.

"Improvement in War and Signal Rockets", No. 87,371; granted to Taliaferro P. Shaffner, of Louisville, Kentucky.

"Improvement in Rockets", No. 119,630; granted to Cornelius E. Masten, of Boston, Mass.

"Improvement in Sky-Rockets", No. 148,553; granted to Jacob J. Detwiller, of Jersey City, N. J.

"Improvement in Rockets", No. 218,394; granted to Charles Morris, of Chicago, Ill.

"Rocket", No. 266,437; granted to Patrick Cunningham, of New Bedford, Mass.

"Rocket", No. 276,007; granted to Jacob J. Detwiller, of Jersey City, N. J.

"Rocket", No. 303,839; granted to John T. Hatfield, of Middletown, Conn.

"Rocket", No. 379,970; granted to Wilhelm Meissel, of Bremerhaven, Germany.

"Line-Carrying Rocket", No. 395,881; granted to Patrick Cunningham, of New Bedford, Mass.

"Rocket-Primer", No. 455,278; granted to Patrick Cunningham, of New Bedford, Mass.

"Combined Carrying Box and Firing-Chute for Rockets", No. 455,279; granted to Patrick Cunningham, of New Bedford, Mass.

"Dynamite Rocket", No. 479,738; granted to Patrick Cunningham, of New Bedford, Mass.

"Rocket - Stand", No. 499,790; granted to William H. Meadowcroft, of New York, N. Y.

"Rocket - Holder", No. 534,651; granted to Henry Krucker, of Cincinnati, Ohio.

"Rocket", No. 585,805; granted to Otto Wilhelmi, of Dusseldorf, Germany.

"Rocket", No. 791,408; granted to Harrison P. Diehl, of Lawrenceburg, Ind.

"Aerial Navigation", No. 918,336; granted to Christopher John Lake, of Bridgeport, Conn.

"Floating and Luminous Line-Carrying Rocket", No. 947,904; granted to Henri E. A. Guerard, of Graville Ste. Honorine, France.

"Rocket", No. 957,210; granted to Thomas G. Hitt, of Seattle, Wash.

"Gyroscopic Rocket", No. 976,732; granted to Nicolas Gherassimoff, of St. Petersburg, Russia.

"Rocket Apparatus", No. 1,206,837; granted to Robert H. Goddard, of Worcester, Mass.

"Rocket", No. 1,297,898; granted to Henry J. Pain, of New York, N. Y.

"Rocket", No. 1,299,217; granted to Henry J. Pain, of New York, N. Y.

"Magazine Rocket", No. 1,311,855; granted to Robert H. Goddard, of Worcester, Mass.

"Signal - Rocket", No. 1,326,494; granted to Robert C. Gowdy, of Cincinnati, Ohio.

"Signal-Rocket", No. 1,326,493; granted to Robert C. Gowdy, of Cincinnati, Ohio.

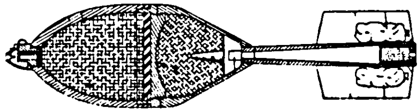
"Magazine Rocket", No. 1,341,053; granted to Robert H. Goddard, of Worcester, Mass.

"Propelling Device," No. 1,375,601; granted to Ernest Morize, of Chateaudun, France.

"Rocket", No. 1,376,797; granted to William W. Case, of Frenchtown, N. J.

"Rocket", No. 1,440,175; granted to Dmitri Riabouchinski, of Guethary, France.

"Propelling Ejector," No. 1,493,157; granted to H. F. Melot, of Paris, France.



Rocket Projectile

"Rotary-Balanced Rocket", No. 1,645,427; granted to Thomas G. Hitt, of Seattle, Wash.

"Rocket", No. 1,653,178; granted to Thomas G. Hitt, of Seattle, Wash.

"Revolving Rocket", No. 1,666,534; granted to Thomas G. Hitt, of Seattle, Wash.

"Rocket", No. 1,666,598; granted to Thomas G. Hitt, of Seattle, Wash.

"Signal Rocket", No, 1,803,366; granted to Charles C. Stetson, of St. Paul, Minn.

"Rocket", No. 1,823,378; granted to Charles Scardone, of Elkton, Md.

"Carbide Rocket", No. 1,856,552; granted to Frank Hadamik and Nick Liberatore, of Union, N. Y.

"Rocket", No. 1,901,852; granted to Hermann Stolfa and Rudolf Zwerina, of Vienna, Austria.

"Rocket Projectile", No. 1,994,490; granted to Leslie A. Skinner, of the United States Army, Aberdeen Proving Ground, Md.

"Rocket", No. 2,043,268; granted to Leslie A. Skinner, of the United States Army, Aberdeen Proving Ground, Md.

"Rocket, No. 2,086,618; granted to Thomas G. Hitt, of Seattle, Wash.

"Rocket", No. 2,191,841; granted to Rudolf Zwerina, of Vienna, Austria.

"Rocket Projectile", No. 2,206,057; granted to Leslie A. Skinner, of the United States Army, Berkeley, Cal.

"Pistol Rocket," No. 2,344,957; granted to Ralph Anzalone, of Oceanside, N. Y

Compiled by C. G.

BOOK REVIEWS

Gas Turbines and Jet Propulsion for Aircraft, by G. Geoffrey Smith. Aerosphere, Inc., New York, 1944; 80 pages, $1.50.

A reprint of the first British book to deal with aircraft plants employing combustion gas turbine and axial compressor combinations. The illustrated "Flight" book contains ten chapters describing the many possibilities of using the jet principle.

Flight Publishing Co., Ltd., London has now available a third and enlarged edition which is priced at 6/-. This latest edition of fifteen chapters has additional subject matter on boundary layer control, turbine-compressor units, and biographic sketches of Group Capt. Frank Whittle, W. G. Carter and Flight Lt. P. E. G. Sayer, experimenters who developed the Whittle jet-reaction plane.

Spacewards, Journal of the Combined British Astronautical Societies. Vol. 5, No. 4, July 1944; 16 pages.

This mimeographed British quarterly contains an editorial on the formation of the C.B.A.S. by the editor, E. Burgess; articles on interplanetary communication systems, and injectors and rockets in war and peace; an astronautical bibliography on literature concerning rocketry; and a brief list of magazine rocket articles.

THE ROCKETOR'S LIBRARY

Rockets: The Future of Travel Beyond the Stratosphere by Willy Ley (287 pages). The early literature, history and development of rockets, and the problems of space travel. Price $3.50.

Gas Turbines and Jet Propulsion for Aircraft, by G. G. Smith (80 pages). American edition of the British book on gas and steam turbines for jet propulsion and driving airscrews. Price $1.50.

Journal of the British Interplanetary Society. February, June 1936. Price 35c.

Das Neue Fahrzeug, May 1937. Publication of the German Rocket Society. Price 15c.

List of Books and Pamphlets on Rocket Propulsion. From 1810 to 1943. Price 25c.

Miscellaneous Drawings. Set of six—50c.

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