NUMBER

4

UNUSUAL ROCKET STORIES

Number Four 2024(3)

INTRODUCTION

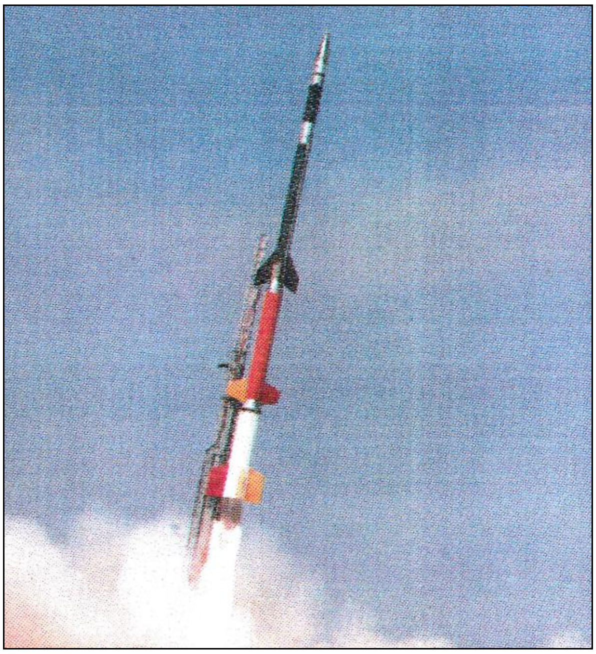
Welcome to the fourth edition of Unusual-Rocket-Stories. This time we have a range of stories and a themed 3-story group of clustered-rocket recollections. The stories are from the US, Canada, Scotland, Germany and the UK this time.

John Pitfield – Editor

CONTENTS

BLACK-BRANT-12 (Canada - 1995)

The Canadian Black-Brant sounding rocket was developed to be the same diameter as the British SKYLARK sounding rocket. It was first launched on 5 September 1959 at Fort Churchill, Canada in its Black-Brant-1 version. It was a very successful product and its 1,014th launch took place at Andoya, Norway on 25 January 1995 in its Black-Brant-12 version. This consisted of four solid propellant stages (TALOS/TAURUS/Black-Brant-5C/NIHKA) all in a rocket which could take a fifth of a tonne of payload to a height of almost 1500 km above the Earth's surface. The 25 Jan 1995 mission was launched at 0624 UT and the firing had been notified to all the local countries and internationally, as has always been the rules. The 15m (49'3") and 3,402 kg rocket lifted off and caused the Russian ballistic-missile-attack warning to go off and according to President Boris Yeltsin, he had to access his "black suitcase" for the first time. The ionospheric and aurora study payload landed under a parachute after ascent to a height of 1453 km, and landed about 850 km NE of Spitzbergen. It quite quickly emerged that Boris had played a joke on the West which coincided with his country's somewhat lack-lustre attack on Chechnya which had begun on 11 December 1994. The scientific notification procedure remains unchanged for sounding rocket launches.



BLACK-BRANT-12 launch

RANGER: US Moon Impacts 1960s

RANGER-1 (P-32) was launched on 23 August 1961, and was intended to test the power, orientation and control systems of the basic spacecraft in an orbit ranging between 1,106,000 and 60,700 km. After being placed in an initial orbit of 446 x 179 km, the AGENA second stage should have fired again for 90 seconds, but shut down almost immediately. Some time later the spacecraft separated from the AGENA to carry out some of the mission, but the regular disappearance of the sun on each orbit disrupted the sensor lock-on so the spacecraft spun erratically until its thrusters ran out of fuel. It re-entered after 6.89 days and completed 111 orbits of the earth.

RANGER-2 (P-33) was launched on 18 November 1961, and was a repeat flight of RANGER-1 with an intended orbit of 805,000 x 61,000 km after being put into an initial parking orbit of 242 x 150 km. The AGENA again failed to fire for the 90 sec escape burn, and the combined assembly re-entered after two days.

RANGER-3 (P-34) was launched on 26 January 1962, and was the first Block-II spacecraft with moon-impact mission together with soft-landing capsule. Television pictures were to be relayed back to earth until a height of 25 km was reached, then the spacecraft turned so that a 2,270 kgf thrust rocket motor by Hercules Powder Co could bring the balsa shrouded 0.61m diameter soft-land capsule inside, 0.3m diameter ball of instruments to a halt at a height of 330m where it would fall to impact at 175 km/hour. Unfortunately the second burn of the AGENA went to completion and resulted in a final velocity of 40,153 km/h instead of the required 39,445 km/h which meant that RANGER-3 would arrive at lunar orbit distance before the moon was there. The manoeuvre engine was fired to reduce speed by 129 km/h by the time the probe had reached a height of 50,000 km from the earth, but the spacecraft missed the moon by 36,793 km. At this point the craft was turned to photograph the moon, but only unusable images were returned, then contact was lost. RANGER-3 entered a solar orbit of 1.163 x 0.984 AU.

RANGER-4 (P-35) was launched on 23 April 1962, and was the second Block II spacecraft to attempt to land a sphere relatively softly on the moon. This time the launch vehicle worked well and RANGER-4 was put on the right course for moon impact, but soon afterwards the on-board timer failed to operate and the first thing that this prevented was the solar panels deploying shortly after 2 hours into the mission. The batteries had run down completely by 10 hours and the craft with its 40.5kg capsule slammed into the moon after 64 hours at 9600 km/h at 15°30'S, 130°42'W being the US first lunar impact.

RANGER-5 (P-36) was launched on 18 October 1962, and was the third and final Block-II Ranger mission with a soft-land attempt. On deployment of solar panels at 1 hour 13 mins, there was an electrical short-circuit and the panels would not work. The batteries had run down by 8 hr 44 mins into the flight and the craft sailed on to miss the moon by 724 km, then passed into solar orbit.

RANGER-6 was launched on 30 January 1964, and was the first Block-III spacecraft with a photographic mission all the way to lunar impact using 6 TV cameras (4 telephoto and 2 wide angle) in a package weighing 172 kg, to be switched on 19 minutes before impact and to start taking pictures fourteen minutes before impact. When the time came to switch on the cameras nothing happened and the spacecraft ploughed into the Sea of Tranquillity at 9°24'N, 21°30'E at 9500 km/hr, after a flight of 65 hours 36 mins. The failure of the cameras had been due to an erroneous checking of the cameras for a 67 second period starting about 2 minutes after lift-off while the ATLAS was still firing

RANGER-7 was launched on 28 July 1964, and was successfully placed on a lunar impact trajectory at 39,324 km/h to impact after a flight time of 68 hr 36 mins, with the final 13m 40 sec taken up imaging through the six TV cameras with 4,316 photos, 4,308 of these being usable. Impact speed was 9,330 km/h and in the final photo craters just 0.4m diameter were shown at the impact point of 10°38'S, 20°36'W in the Sea of Clouds. The last picture showed an area 32 x 46 m, taken just 0.19 sec before impact. The crater created by the impact was photographed by APOLLO-16 in 1972 and had a diameter of 14 metres. The International Astronomical Union named the impact area Mare Cognitum (Known Sea) in honour of the success of the mission.

RANGER-8 was launched on 17 February 1965, and was the third Block-III Ranger spacecraft successfully sent on 64 hr 53 min flight to moon with the final 23 min 8 sec being used to send 7,137 television pictures back to earth. The last image was taken at a height of 469 metres above the Sea of Tranquillity impact site of 2°43'N, 24°38'E. The first image covered an area of 2,331,000 km.

RANGER-9 was launched on 21 March 1965, and was another successful RANGER lunar impact photographic flight with a 64 hr 31 min duration mission to impact near the crater Alphonsus at 12°58'S, 2°22'W. The cameras switched on at a height of 2,262 km and then took 5814 pictures which were usable from the 6,007 taken with the last at 0.2 sec at a height of 612 metres, with 0.25m resolution. The initial area photographed was 417,054 km^2.

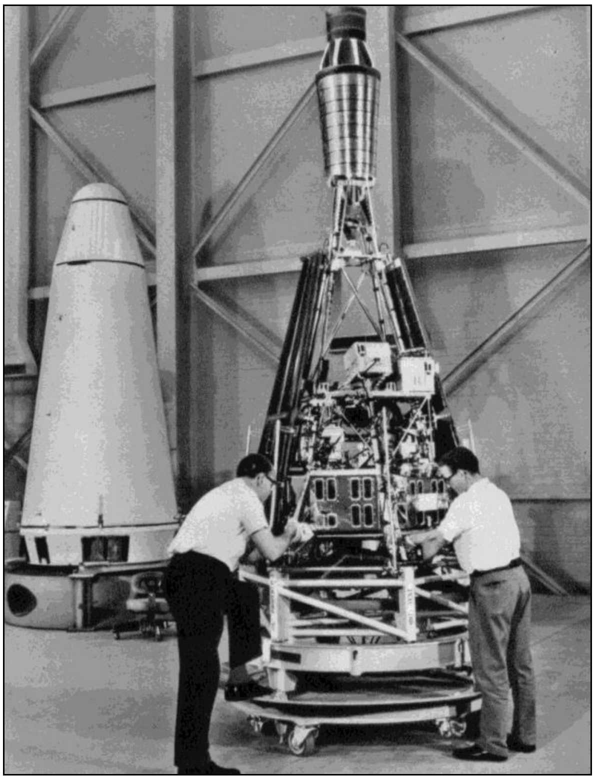
RANGER: Project Summary

The RANGER moon exploration missions were launched from Cape Canaveral on Atlas-Agena-B launchers in a programme which cost $260 million. The purpose of the flights was to provide data about the lunar surface in preparation for the APOLLO missions of the late 1960s and early 1970s.

The LUNAR-ORBITER and SURVEYOR missions followed but RANGER gave the first data in a way that ground-based telescopes never could. After the success of RANGER-9 the further missions of numbers 10 to 14 were cancelled. RANGER-1 and 2 were Block-I spacecraft (306kg), while RANGERs 3,4 & 5 were Block-II (330-342kg), and the final RANGERs 6,7, 8 & 9 were Block-III (366kg).

At the end of the Block-II flights a NASA inquiry found that the heat-sterilisation at 125°C for 24 hours caused severe electrical failures and the practice was stopped. This had resulted in the failures of the soft-landing spheres which together with their retro-rockets were called "TONTO" and weighed 136 kg. If they had soft-landed they would have measured moon-tremors, radiation and temperatures.

A similar soft-landing technique was attempted by the Soviet Union with LUNAs-4, 5, 6, 7, 8 and finally succeeded with LUNA-9 in 1966.



RANGER spacecraft & nose cone

MERCURY-REDSTONE-3

America's response to the orbital flight of Yuri Gagarin in VOSTOK-1 took place just three weeks later, but instead of an orbital shot, was suborbital. The plan was to send the MERCURY capsule to orbital height, but with only enough energy for a landing 300 miles downrange to take place.

Despite the event being over sixty years ago, it is remembered with greater clarity than the Soviet flight, due to the secrecy of Gagarin's launch when compared to the huge publicity afforded to Alan B. Shepard's mission. The factors involved for MERCURY's publicity involved about 500 journalists, including some from ten other countries, at Cape Canaveral for the launch, who excitedly conveyed the bravery, technological marvel and national pride in the event. On top of this were the imagery in "glorious Technicolor" and Walter Chronkite's consummate laconic skill.

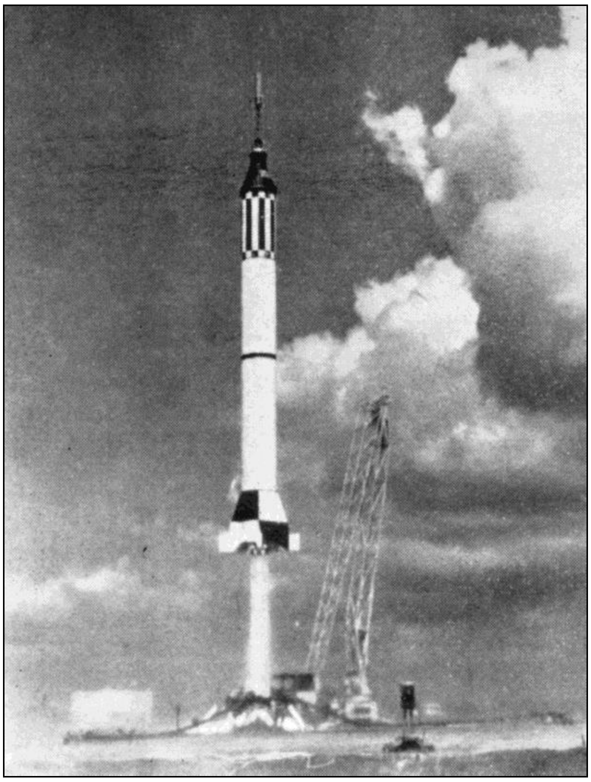
On 2nd May 1961, the launch was attempted at Pad-5, Cape Canaveral, but eventually had to be scrubbed due to weather in the launch and recovery area. The flight had been intended to begin at 0700 Local Time (1200UT) and after the cancellation the astronaut's name was revealed for the first time - that of Alan Bartlett Shepard, who was aged 37. He had named his spacecraft "Freedom-7" and it was capsule No. 7 and was riding Mercury Redstone MR-7 rocket, despite the mission itself having the MR-3 series name. The REDSTONE was the 71st to be launched since 1953, and had numerous modifications to improve the already reliable flight record. The spacecraft weighed 1,832.6 kg and 1,295 kg without the Launch Escape System (LES) which consisted of a nose-tower mounted rocket to pull the capsule to safety in the event of a malfunction with the booster. John Glenn was the back-up pilot to cover any injury or illness of Alan Shepard.

The second attempt was successful on 5th May 1961. Alan Shepard (18 Nov 1923 - 22 Jul 1998) reached the pad at 0515 Local Time for a planned 0700 lift off, but there was a delay of a further 2 hr 34 mins due to a booster electrical fault, described as a "faulty inverter", which was replaced. Finally 13 seconds after 0934 Local (1434 UT) the rocket lifted off and arced up over the Atlantic Ocean to reach a maximum height of 115.769 miles (186.4 km), according to the FAI registration of the flight. Shepard experienced about 5 minutes of weightlessness and made five attitude control manoeuvres, made 78 voice communications and performed 27 capsule functions.

He splashed down, under the main parachute at 297 miles (478 km), about 7 miles (11.3 km) from the predicted point, and at 27°13'7"N, 75°53'W, not far from the recovery ship USS Lake Champlain, after a flight of just 15 minutes 22 seconds. The difference of the landing position had been due to a higher all-burnt velocity than was predicted. A helicopter from the USS Lake Champlain, a Sikorski HUS-1, winched Shepard aboard, then picked up the floating capsule to place both aboard the ship. Medical checks and debriefings followed, both on the ship and at Grand Bahama Island.

On 8th May 1961 Shepard gave a press conference, lasting about 50 minutes, and summed up the flight saying he experienced "no bad problems." Before this he had his "tickertape" parade along Pennsylvania Avenue to the White House in Washington to meet President Kennedy, who presented him with NASA's Distinguished Service Medal. Shortly after this a US news agency had estimated that every American had contributed $2.32 to make the flight possible, and for a while NASA was inundated with sackfulls of mail containing checks (cheques) for that amount!

America had a man in space, but it would not be until February 1962 that an orbital flight matched Gagarin's achievement.



Lift-off of MERCURY-REDSTONE-3 at Pad 5, Cape Canaveral at 0934 Local Time.

19-CLUSTER (UK - 1995)

We have all heard of a 3-cluster solid rocket, some have tried a 4-cluster and fewer have tried a 7-cluster. It gets difficult to ignite all the motors at the same time as the number goes up. An experiment was tried in 1995 with 19-motors and the purpose was to get all 19 motors ignited at the same time. The system used was a "bagged-ignition" where all the solid motors had identical-length fuses enclosed in a thick paper "bag" with a small 4FA charge connected to the igniter which on firing pressurised slightly to light all the fuses simultaneously and it worked perfectly when launched on 25 June 1995 in a rocket called XRC-1134 fired at Pad-24B on a sea-range using Gantry-20. The motors were all a device called "TUTU" each with a thrust of about 0.5 kgf and a burn time of about 6.5 seconds. The ascent was vertical with good stability but some motors finished before others and a slight tumbling set in, but it still rose to a height of about 400 feet then gently descended to land at about 50 yards range, without plopping into the sea.

XRC-1134 preparation & lift-off at Pad-24B

30-CLUSTER (USSR - 1969)

When the USSR and the USA had their "moon-race" at the end of the 1960s the US was concerned that the USSR's D-1 PROTON launcher had already sent Soyuz capsules around the Moon in the ZOND programme and recovered them in the Indian Ocean. What they didn't know was that the N-1 moon rocket was in preparation to launch a two-manned Soyuz with a "lunar lander" for a Soviet soft manned landing. The first stage needed enormous power and their solution was to cluster 30 liquid engines in a huge slightly conical cylinder. All four launches between 1969 and 1972 were unmanned and getting the multiple-engine stage to work was the biggest problem of all. Vibration was a big problem and when pipework began to fracture, the after effects were that various engines began shutting down causing even more accelerations and breakages. The mass-produced engines that were spare to the project were later sold to the US and used in their ATLAS-5 launchers from the 1980s & 1990s.

The first N-1 was launched on 21 February 1969. The 100m (328 ft) long rocket with thirty engines on the first stage lifted off well, but at 69 seconds at 30.5 km (19 miles) altitude, the rocket exploded showering debris over an adjacent area near Tyuratam-Baikonur, killing 91 people at a ground range of 54 km (33.5 miles).

The second N-1 was fired on 3 July 1969, ended at or shortly after lift-off, when the booster exploded destroying both launch pads. The re-entry module was saved by the launch escape rockets. The cause of the failure was the ingestion of a bolt or other debris by one of the engines, then the others began shutting down. The rocket tipped over beginning at 8 seconds and impacted at 0.2 km, while the capsule landed at 1 km.

The third N-1 was launched from Tyuratam on 26 June 1971, but the guidance system suffered a malfunction at 39 seconds, and resulted in excessive roll, which caused some breakage in the interstage structure between the first and second stages by 47 seconds. At 52 seconds and at a height of 6 km (3.7 miles) the first stage shut down and the rocket curved over to impact at a distance of 16 km (10 miles) where it made a crater 12m (40 feet) deep. Scrap metal was salvaged from the hole for years afterwards.

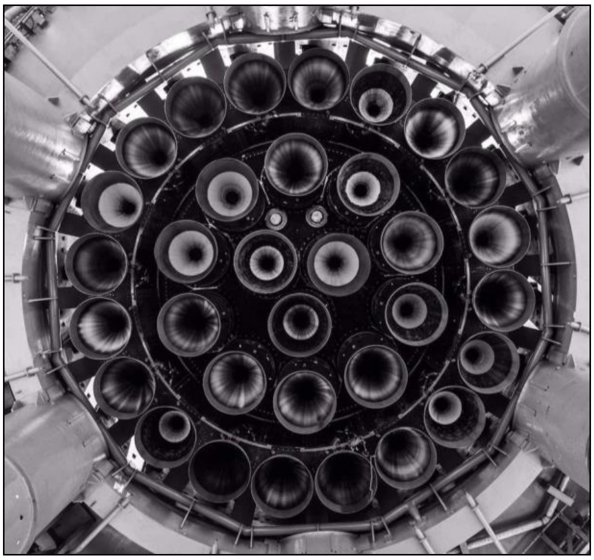
Soviet N-1 moon-rocket

The fourth N-1 launch was on 23 November 1971 was the last attempt with the Soviet Moon-rocket. Built to be more reliable than the previous versions of the N-1. The rocket took off as planned, and ascended until the six central engines shut down as planned, at 90 seconds to reduce acceleration loads, but the negative shock of the reduction in thrust broke some fuel lines and a fire began in the engine compartment at about 96 seconds. At 105 seconds some of the other 24 engines began exploding, and at 107 seconds all of them shut down by command. The launch escape system then fired, and at a height of 40 km (25 miles) the destruct signal was sent at 108 seconds and the remains fell back to Earth. The intended burn time of the first stage had been 116 seconds.

33-CLUSTER (USA - 2023)

Space X's Starship "Super Heavy Booster" has a first stage that uses 33 Raptor-2 liquid engines, three more than the USSR's N-1 rocket of the 1960s. The launch programme, at the time of writing, has consisted of six firings, of the "all-up" type, not testing the individual stages separately. The launches have been on 20 Apr 2023, 18 Nov 2023, 14 Mar 2024, 6 Jun 2024, 13 Oct 2024 and 19 Nov 2024, and all from the Boca Chica site in Texas. On the fifth launch the first stage returned to the launch site, using three of the engines as retros and clipped itself back onto the support arms on the launch tower after about 7 minutes. On the most recent launch on 19 November 2024, the first stage burned for 2m40s but landed in the sea in the Gulf of Mexico after 6m55s and was lost. The second stage continued across the Atlantic, Africa and finally sea-landed off the West coast of Australia after reaching an apogee of 190 km but had descended to 151 km at 9 minutes. The maximum velocity had been 26,815 kph (16,655 mph); not enough to reach orbit. The Raptor engines use Liquid Oxygen and liquid methane, and some of the early launches, reportedly, suffered extreme vibration during first stage operation.

All information obtained from the SpaceX live streams.



STARSHIP first stage engines

RHEINTOCHTER-R1

Rheinmettal-Borsig received the development contract for this surface-to-air missile on 23 November 1942, under the terms of the Von Axthelm report conducted for the German Ordnance Department. The work was carried out at the company’s Berlin-Marienfeld factory and followed the request by the Luftwaffe to produce a missile with a ceiling of 12,000m (39,000 feet) to counter the increasing Allied bomber missions over the country.

The missile had two solid-propellant stages of 0.55m (21.6″) diameter, both with clustered motors powered by solid sticks of Diglycol dinitrate. Total length was 6.3m (20’8″) with the first stage being 2.3m (7’7″) long and the second 4.0m (13’1″) long.

The first stage weighed 650 kg, and had four large fins with a span of 2.74m (9’). Thrust produced was about 65,000 kg for 0.6 seconds from 240 kg of propellant, from a seven-cluster pack. After burnout, the stage sheered four bolts and fell away before the second stage ignited. Tracking flares on the second stage had been set going just before liftoff.

The second stage had six large fins at the rear, of 2.22m (7’3.4″) span, and four canard movable nose fins for control. Thrust from a ring of 6 motors was 4,000 kg for 10 seconds from 220 kg of propellant. Exhaust was through the six nozzles situated between the fins, which left the rear section of the missile available for the 133 kg warhead. The warhead was to be triggered by either the “Kranich” acoustic proximity fuse, or the “Kugelblitz” Doppler radio proximity fuse. The forward canards were controlled by a gyro-stabiliser with additional commands being applied from a Radio-Control system called “Brabant” which operated on 3000 or 600 Mc/s. It was later proposed to use “Franken” radio control sent via the “Kogge-Brigg” transmitter. During the test programme, almost all of the available control systems were tried with the RHEINTOCHTER-R1, but surprisingly only about a quarter of all test flights had any guidance fitted. The rest used autopilots only.

The flight test programme got under way in August 1943 at Libau in Poland (called Leba by the occupying Germans) on the Baltic Coast, and was notable for its success. By July 1944, a total of 34 had been fired, but at this point the Luftwaffe had decided that they wanted a missile with a higher ceiling, so the R-1 programme was turned into a pure research series. It had been found that although the maximum height with the R-1 was to specification, it had peaked in its trajectory and had no manoeuvring capability as speed had dropped to almost zero, so lower angle firings had to be used to maintain control.

The maximum effective height was just 6,000m (20,000 ft) where useful range was 12-16 km. All launches were made from a frame mounted on an 88mm antiaircraft gun mounting, and the maximum speed had to be kept below 680 mph so that the controls were still effective. At lower angles speeds of up to 800 mph were achieved, but with loss of control until the speed had decreased.

By 22 September 1944, a total of 45 had been fired, and by December 1944, the 82nd and last had been launched with only a few failures. Of those 82, just 22 had used guidance, but 18 of these were successful.

The whole RHEINTOCHTER project was officially cancelled on 6 February 1945 in favour of other projects with a higher chance of success, but despite this there was a plan to fire 20 RHEINTOCHTER-R1 missiles at Peenemünde on 20 February 1945 to dispose of remaining stocks, but this did not happen, and instead the Russians seized the hardware as they pressed through Poland and took the equipment back to their own country.

RHEINTOCHTER-R3

When the Luftwaffe revised their requirement for their surface to air missile to reach a ceiling of 15,000m (49,000 ft) in July 1944, Rheinmettal-Borsig had, since May 1944, been working on another plan with the RHEINTOCHTER-R3 missile. It was considered that above-ground emplacements would be vulnerable, so the new plan called for a shorter missile to be fired from below-ground pits, with specially constructed launch structures.

The reduction in length was achieved by the use of four wrap-around boosters instead of the tandem-booster used in the R1. These four constituted the first stage and were each of 110 kg weight and produced a thrust of 6,250 kg each for 0.9 seconds, and were mounted part-way up the fuselage near the centre of gravity of the whole missile. Total thrust was 25,000 kg and the propellant used was Diglycol-dinitrate. The missile had a total length of 5.0m (16′6″) and a diameter similar to the R-1 at 0.54m (21.2″). Weight at launch was 1,565 kg. The four boosters were placed between four stout wooden wings with a span of 3.0m (10 ft), each with a red flare mounted at the tip for visual tracking. Near the nose, there were four wooden canard fins for guidance control, with commands coming from the gyro stabilised platform and the radio-control system. The warhead was mounted mid-body this time with detonation control by either an acoustic proximity fuse or by radio-command from the ground.

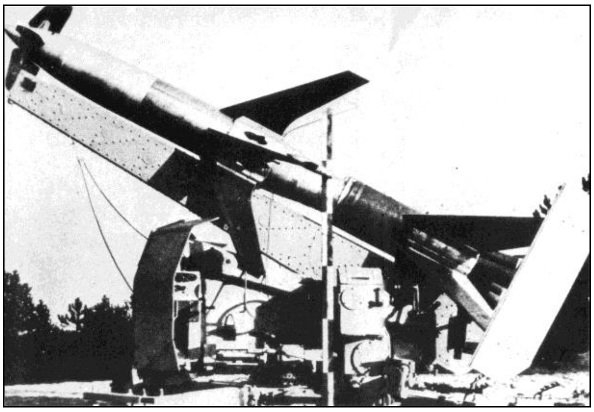
The second stage, the central body, was intended to be powered by an engine by Konrad and being a derivative of the "P-9" engine used in the Wasserfall SAM, but with a reduced thrust of 2041 kg for 38 seconds, and using 424 kg of liquid propellant (Visol/SV-stoff). The second stage arrived at the target area with a weight of 680 kg including the 159 kg warhead.

The performance of the missile was such that the maximum velocity would be between 1200 and 1500 kph (750 and 920 mph) at a range of 18 km (11.2 miles), with final ground impact at 35 km (21.7 miles) if no interception took place.

The flight test programme began in January 1945 at Libau in Poland, but the first five used solid propellant second stages, as the liquid units were not ready. The last launch used a liquid propellant engine and was successful but at this stage of development, none had been guided, all being flown on auto-pilot, and the project was stopped completely on 6 February 1945. Like the R-1, it had been planned to fire some (15 missiles) at Peenemünde for demonstration purposes, on 20 February 1945, but this idea never materialised.

RHEINTOCHTER-M

In the final months of 1944, the Rheinmettal-Borsig development team began work on what became known as the RHEINTOCHTER-M (for "manned") project. Instead of housing the command electronics and proximity fuse system in the nose of the 0.54m (21.2″) diameter front end of the R-3 missile, it was proposed to house a prone pilot who would steer the missile based on information from the ground, into an Allied bomber formation. It was planned that the pilot would bale out of the missile in the final moments of the attack and return to Earth for perhaps another mission. It is clear that at this stage of the war, suicide missions were receiving more serious thought, especially unofficially. The project never progressed from the proposals on the drawing boards at Rheinmettal-Borsig.

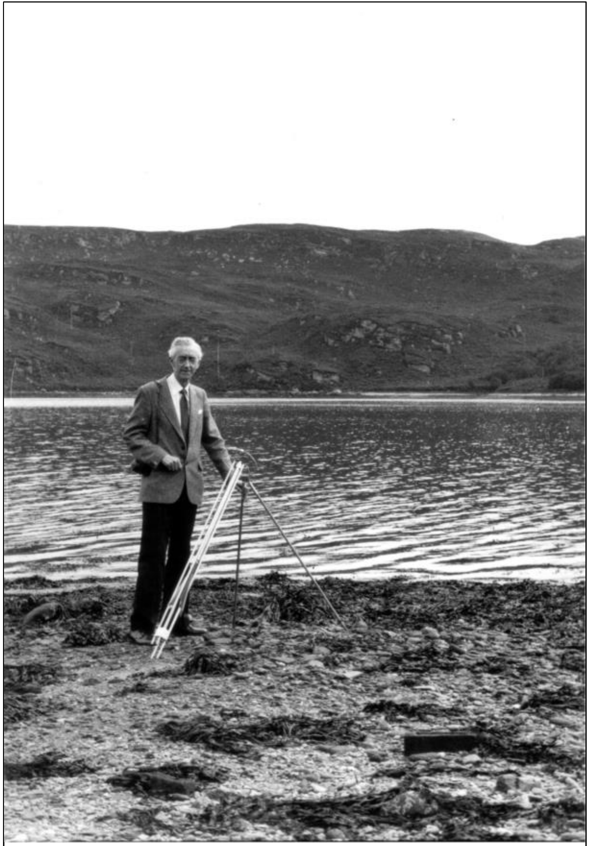


Rheintochter R1 on Launcher in 1943

JOHN D. STEWART

John D. Stewart, one of Britain's rocket pioneers, has died aged 83 in Paisley, Scotland. Amongst many innovative projects that he led was the first three-stage rocket launch in the UK on the last day of 1937.

One of the initial inspirations for John Stewart's rocketry had been the tour around Britain of the German mail-rocketeer Gerhard Zucker in 1934 including his attempted flights in the Hebrides that summer. Several rocket experimenters in the 1930s used the carrying of rocket mail to finance their flights. These items were carried to demonstrate the use of rockets and to carry mail to inaccessible places like islands and across mountain ranges. The subsequent sale of these postcards and letters with stamps turned into a lucrative source of income from certain stamp collectors.


John D. Stewart about to fire a rocket model over a small bit of the Atlantic Ocean in 1982

Being Britain, there was no source of proprietary rocket motors, so fireworks were pressed into service for these flights. Instead of carrying sky-burst stars, the front compartments were ideal as mail compartments. Together with a small group of school friends, John Stewart began his rocket flights on 27th November 1935 with a rocket that had the distinction of taking off and landing four times.

If the first rocket had worked properly, the flights would probably have stopped after the novelty had worn off, but the desire to master the techniques resulted in the formation of the Paisley Rocketeers Society (PRS) on 27th February 1936. Members soon included Arthur C. Clarke and Eric Burgess, both leading lights in the formation of the British Interplanetary Society.

1936 was a busy year, with the construction of a thrust-measuring device, and the testing of a gas-rocket using coal-gas and compressed air. Then in 1937 the flight distance record was raised to 580 feet, but the rocket landed in a road and was run over by a vehicle and squashed, before the boys could recover it.

Between 1935 and 1939 the PRS launched sixty one rockets, including Britain's first three-stage rocket and a camera payload, which on its first flight on 22 August 1938 photographed some clouds. Also in 1938, experiments with rocket-aircraft began. These other experiments were made while the mail rockets continued to be flown, most carrying several or dozens of postcards and letters. A two-way birthday message was sent by rocket to a member, the first wishing the boy a happy birthday and the return flight thanking the Society for the felicitations. On the occasions when the rocket-mail was scorched or got wet in a river or loch landing, these markings only increased the value of the rocket mail to collectors.

During the war and until 1965, John Stewart was employed as an industrial designer, first in Scotland and later in London.

Persuasion from philatelists in the 1960s resulted in the Paisley Rocketeers re-forming for their 30th anniversary on 27th November 1965 when the 62nd rocket was launched. From then until 1969 a further 26 rockets were launched, all carrying rocket mail for collectors and to raise money for charities. But in 1969 the full weight of the government machine descended on the rocketeers, due mostly to the Home Office Explosives Branch's incorrect interpretation of a report that the rocket motors were inserted into the back of the models. The Home Office assumed that explosives were being mixed and hammered into tubes instead of the entirely innocent application of an existing product. It was true that the change in use of these products was, strictly speaking, not according to the law, as is still the case, and so the ban had to be observed.

In 1966, it had been drawn to the PRS's attention that water-powered "rockets" were being marketed, and this solution was put in hand, so that flying rocket mail could continue. These items are on sale in every toy shop in the world now, but in the 1960s only one firm was making them. Improved types were developed using "Fairy Liquid" bottles and pumps and release mechanisms. The introduction of "Cola" bottles of 2 litre size resulted in the ultimate "Aquajet" as John Stewart dubbed these devices, and distances of up to 850 feet were eventually obtained.

Many hundreds of mail flights with Aquajets followed into the new century, while about two dozen conventional rockets were also flown from 1974 onwards, coinciding with the huge world-wide growth of the model rocketry hobby and sport. The business of inserting motors into models was finally sorted out with the UK government in the 1980s with pressure from the British Space Modelling Association, and since then Britons have been able to compete in the World Space Modelling competitions and have, on occasions, done very well. John Stewart was a pioneer of both model rocketry and water-propelled toy rockets which have given pleasure to millions around the world. Sport rocketry is now a respected activity with an unrivalled safety record.

John D. Stewart, rocket pioneer, born 3rd Sept 1921, died Paisley, 28 March 2005. (JP)