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# Chapter 13

# CAMERA ROCKETS AND SPACE PHOTOGRAPHY CONCEPTS BEFORE WORLD WAR II PART II*

Frank H. Winter†

In the author's earlier paper, we saw that between 1901 and approximately 1915 Alfred Maul of Saxony, Germany, designed, constructed, and successfully tested a series of several sophisticated camera rockets, which took single-frame photos of Earth from altitudes up to 800 m (2,625 ft). Maul's rockets were meant for reconnaissance. They were designed for the Army of Saxony, who provided Maul with soldiers as assistants and may also have helped finance the research.

We saw too, how Maul's camera rockets suddenly became impractical with the introduction of airplane-borne cameras in World War I. Airplane cameras offered overwhelming advantages over rocket cameras. To cite but a few, a photographer aboard an airplane could snap many photos during one flight, compared with a solitary picture for the rocket. The aviator-photographer was infinitely more selective and precise in taking his photos, whereas photos taken by a rocket were haphazard and relied largely upon luck and the absence of clouds. In short, the very notion of a camera rocket as a potential reconnaissance tool ceased entirely.

On the other hand, as also detailed in the writer's earlier paper, all four of the leading astronautical pioneers—Konstantin E. Tsiolkovsky, Robert H. Goddard, Robert Esnault-Pelterie, and Hermann Oberth—considered cameras, or photography from rockets, as logical tools for exploring both Earth and space. The widespread interest in the works of these pioneers led to an international astronautical movement, which was in full bloom by 1930. Consequently, several other individuals produced their own concepts and projects along these lines during this period.

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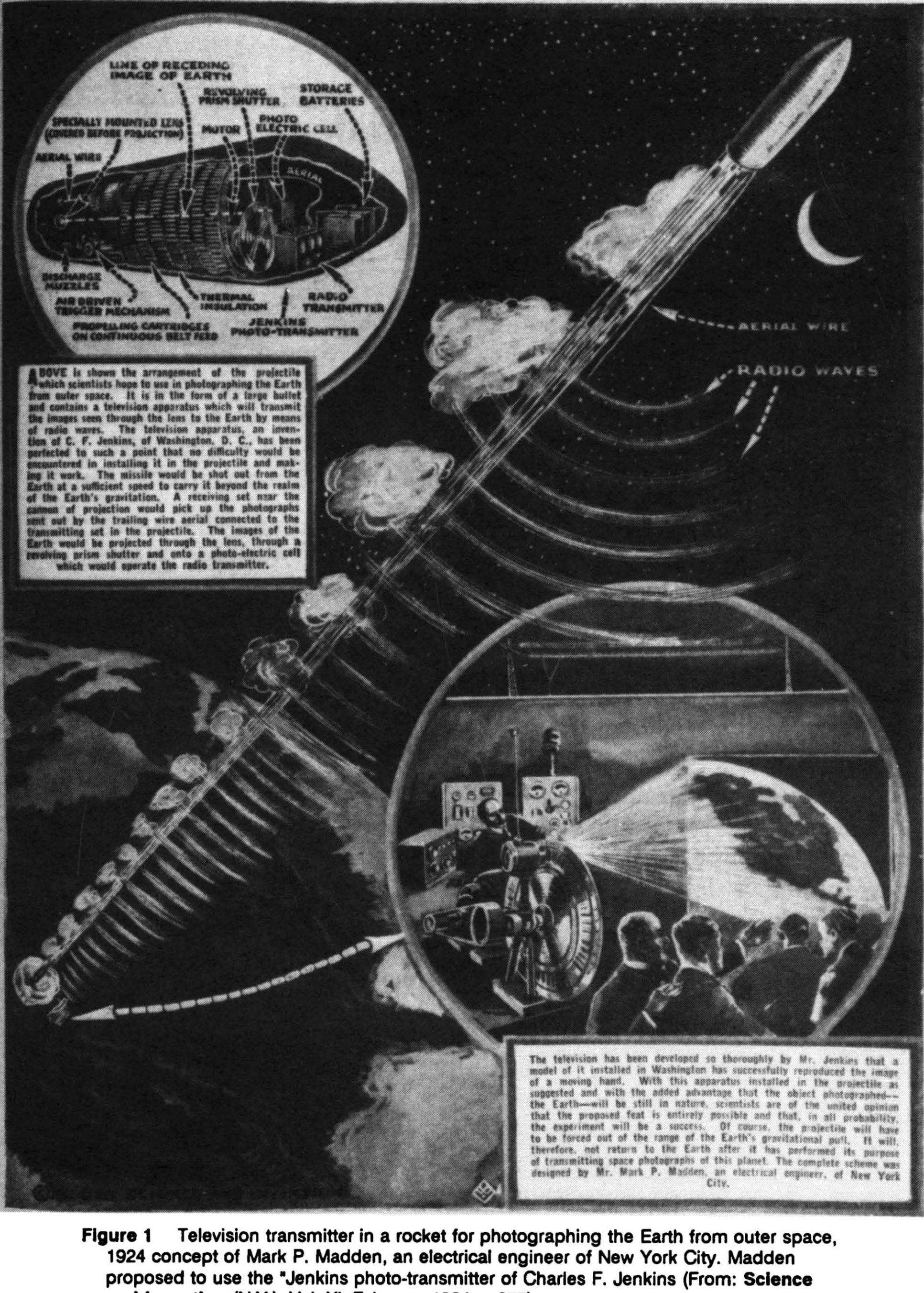
# Picture of the Earth

**Radio Television to Photograph Earth from Space.**

BY RAYMOND FRANCIS YATES




ABOVE is shown the arrangement of the projectile which scientists hope to use in photographing the Earth from outer space. It is in the form of a large bullet and contains a television apparatus which will transmit the images seen through the lens to the Earth by means of radio waves. The television apparatus, an invention of C. F. Jenkins, of Washington, D. C., has been perfected to such a point that no difficulty would be encountered in installing it in the projectile and making it work. The missile would be shot out from the Earth at a sufficient speed to carry it beyond the realm of the Earth's gravitation. A receiving set near the cannon of projection would pick up the photographs sent out by the trailing wire aerial connected to the transmitting set in the projectile. The images of the Earth would be projected through the lens, through a revolving prism shutter and onto a photo-electric cell which would operate the radio transmitter.

The television has been developed so thoroughly by Mr. Jenkins that a model of it installed in Washington has successfully reproduced the image of a moving hand. With this apparatus installed in the projectile as suggested and with the added advantage that the object photographed—the Earth—will be still in nature, scientists are of the united opinion that the proposed feat is entirely possible and that, in all probability, the experiment will be a success. Of course, the projectile will have to be forced out of the range of the Earth's gravitational pull. It will, therefore, not return to the Earth after it has performed its purpose of transmitting space photographs of this planet. The complete scheme was designed by Mr. Mark P. Madden, an electrical engineer, of New York City.

**Figure 1** Television transmitter in a rocket for photographing the Earth from outer space, 1924 concept of Mark P. Madden, an electrical engineer of New York City. Madden proposed to use the "Jenkins photo-transmitter of Charles F. Jenkins (From: **Science and Invention** (N.Y.), Vol. XI, February 1924, p.977).

One of the more exotic was the suggestion of television transmission from space. Like many complex technologies, television evolved gradually over many years through different stages. One of those milestones was reached in 1923 when J. L. Baird in England and Charles F. Jenkins of the United States demonstrated the electrical transmission of crude black-and-white silhouettes of a moving hand. An obscure electrical engineer of New York City, Mark P. Madden, was perhaps the first to suggest the "Jenkins Photo-Transmitter" as an ideal instrument for broadcasting photos of Earth from a space rocket, in which the rocket would not return to Earth once it escaped Earth's gravitational pull. A pictorial description of Madden's idea appears in the American Popular Science magazine *Science and Invention* for February 1924, which shows the installation of a radio transmitter and antenna wire trailing from the rocket as it departs from Earth (Figure 1). The special optical lens at the base of the bullet-shaped, single-stage rocket was closed prior to the flight (i.e. the launch), presumably to protect it from exhaust gases. The light rays captured by the lens were projected through a revolving prism shutter driven by a storage (i.e. chemical) battery-operated electric motor in the forward part of the rocket, and onto a photo electric cell which, in turn, relayed the electrical impulses through a radio transmitter. A "receiving set" near the launch site was to pick up the signals and project them onto a screen for scientists on Earth. The actual use of these images was not mentioned [1].

Madden's rocket was based directly upon Robert H. Goddard's World War I vintage solid-propellant (doublebase), cartridge-feed design. The propellant cartridges were fed into the "discharge muzzles" (i.e. combustion chamber) of the Madden rocket by means of a continuous belt feed mechanism similar to that in a modern machinegun. By the time of Madden's proposal (1924), Goddard had already abandoned solid propellants in favor of liquids. On 16 March 1926, he accomplished his first flight with a liquid propellant rocket. However, Goddard's liquid propellant work was then conducted in virtual secrecy (known only to his assistants and his Smithsonian Institution sponsor), so it is obvious that Madden was only familiar with the much-publicized cartridge-feed system, otherwise he probably would have incorporated a liquid (and possibly multiple stage) rocket into his scheme. One noteworthy modification he apparently did make of Goddard's solid cartridge design was the addition of thermal insulation around the rocket shell. No other instrumentation is depicted for the rocket apart from the Jenkins photo-transmitter [2].

The identical illustration was published that same year in the Russian popular science magazine *Tekhnika i Zhizn* (Technology and Life) for December 1924. No credit is given to Madden. But rudimentary television was already known in the U.S.S.R. The well known Russian spaceflight advocate Fridrikh Tsander had already suggested the "testing of television for rockets" in an outline of a report he presented on 15 July 1924 before the newly founded Society for the Study of Interplanetary Communication (OIMS). In the same report, he also proposed that the Society conduct an "investigation of the upper layers of the atmosphere with rockets, balloons, and photometric observations of twighlight . . ." Unfortunately, there appears to be no elaboration of these ideas from Tsander's outline [3].

In the same year, however, Tsander did provide some details of a plan for sending a rocket with a "camera obscura" to the Moon. This plan is found in his "Report of Engineer F. A. Tsander Concerning Interplanetary Voyages" and was evidently one of a series of slide lectures he delivered in Moscow and other Soviet cities throughout 1924 and 1925 in his capacity as the chairman of the OIMS scientific research section [4].

". . . By covering the entire matte plate [of the camera obscura] with selenium," he said, "all images on the plate can be transmitted. If a rocket with such an apparatus approaches the Moon, we will be able to see the Earth images in the camera obscura of the rocket approaching the Moon. However, these plans require further development." As with Madden's TV rocket, Tsander does not specify how these Earth images were to be used [5].

In the December, 1931 issue of the American popular science magazine *Modern Mechanix and Inventions* appeared a very similar "television apparatus for a long-distance view of the Earth." This "ingenious television rocket" was proposed by Maxium Pudovkin, identified only as "a young Russian engineer." The mechanism of both the rocket and the television was not detailed, but in any case differed little from Madden's original concept seven years before. The only differences are that Pudovkin's rocket was to head toward the Moon and that applications are mentioned: "checking up on maps and geographics." However, this idea was also not new, since it was anticipated in 1923 in Hermann Oberth's *Die Rakete zu den Planetenräumen* (Rockets in Interplanetary Space), in which he suggested photography from Earth-orbiting space stations for "use in geography and ethnology." (These, and other concepts of Oberth concerning space photography are treated in the author's earlier paper.) The only feature that does appear to be original in Pudovkin's plan was that of keeping ". . . a photographic record of the television image . . ." received from space [6].

In 1929, Hermann Noordung of Austria elaborated upon Oberth's concept of the space station, and wrote the first book devoted entirely to this topic, titled *Das Problem der Befahrung des Weltraums* (The Problems of Space Flying). Noordung likewise borrowed Oberth's ideas upon the applications of the station. "Valuable preliminary work," he wrote, ". . . could be done for expeditions planned, and even photographic detail maps could be furnished for new lands to be visited. This indicates that cartography would rest on an absolutely new basis; for by means of telephotography ['Fernphotographie'] not only could entire countries and even continents be mapped from the [space] observatory (a task requiring otherwise many years and corresponding amounts of money), but also detail maps on any scale could be made, not surpassed in exactness even by the most scientific work of surveyors and mappers." Noordung, again closely following Oberth's 1923 book, also proposed Earth weather observations and military reconnaissance from the space station, though he did not link these with photography [7].

Noordung did stress the use of the space station for astronomical observations: "Our entire solar system, with all its planets, asteroids, comets, big and little moons, etc. could be investigated in the minutest details. . . The surfaces of all the neighboring heavenly bodies, the Moon, Venus, Mars, and Mercury, could be closely examined so far as they are visible to us and could be mapped by telephotography. Even the question of the habitability of the planets might probably be definitely decided." The extreme remoteness of the more distant planets, Noordung felt, "prevents more exact observation." [8].

Robert H. Goddard seems to have really been the first to carefully think out the possibilities of using camera rockets to take pictures of the planets. These ideas, which included camera rockets orbiting Mars and returning to Earth with exposed photographic plates ready for recovery, date between 1908 and 1910. However, they were ideas Goddard only confided to his notebooks. Credit should therefore also go to the Austrian astronautical pioneers Franz von Hoefft and Max Valier for independently arriving at the same basic concept, though to a less developed degree. On 29 March 1925, Valier wrote that he would refine his ideas on spaceflight: "following [the] trains of thought of Dr. von Hoefft, to machines which lift recording apparatus initially to an altitude of only several hundred kilometers, then thousands, then hundreds of thousands of kilometers. In continuation of this approach[,] there are machines which could carry a large Hoefft-Scheimflug [sic] sequence camera, stereoscopic cameras, for example, around the Moon and finally, as von Hoefft wrote to me in his letter, could even forge ahead unmanned as far as Venus and Mars and could bring back to us from there photographs of these celestial bodies from close quarters." (Possibly von Hoefft had earlier teamed up with fellow Austrian Theodore Scheimflug, the distinguished pioneer in photogrammetry, the process of making maps or scale drawings by aerial or other photography; a sequence camera was evidently an aerial still camera which automatically advanced each frame.) [9].

In speaking of von Hoefft's own approach to spaceflight, Valier was referring to von Hoefft's proposed modular evolution of rockets from his small liquid-propellant RH I ("Ruckstossflugzeug Hoefft Nr. 1," or "Hoefft Reaction Aircraft Nr. 1"), designed for meteorological exploration up to 10 km (6 miles) to his RH VIII, composed of combinations of smaller RH units and capable of penetrating space. Von Hoefft undertook these designs during 1925 to 1928. The RH III was a two-metric ton (4,400 lb), two-stage model designed to explode flash powder on the surface of the Moon, so that the rocket's progress could be observed by a telescope from Earth (an idea borrowed directly from Goddard's 1919 *Method of Reaching Extreme Altitudes*). In addition, the RH III could take along a camera for photographing the far side of the Moon. Stability for the flight was achieved by a gyroscope. The rocket's nosecone, containing the camera, later returned to Earth, parachuted down for recovery. The RH-IV's second stage was the same as that of the RH III, but in this case the RH IV could transport either mail or carry a camera for taking photos of the Earth at any point on the globe along a Keplerian ellipse in one hour's flying time. Von Hoefft specified that the purpose of the photos was cartography [10].

In America, aside from people like Mark P. Madden and the secretive, Robert H. Goddard, the international astronautical movement had really not taken flower until 1930. The movement in that country was heralded by the founding of the American Interplanetary Society that year. This small group (afterwards called the

American Rocket Society) initially consisted largely of science fiction writers and contained no theoreticians or pioneers of the stature of Oberth, Tsander, or von Hoefft (Goddard remained independent and became an honorary member). Nonetheless, the single March-April 1931 issue of the mimeographed *Bulletin of the American Interplanetary Society* contains several interesting suggestions of space photography. Member Adolph L. Fierst, one of the original founders of the Society and a copy editor of *Science Wonder Stories*, reported upon his design of a step rocket, the last stage of which was to geosynchronously orbit Earth as a space station at 28,260 miles (45,478km) altitude. The primary mission of this station was astronomical observation, "undimmed by any atmosphere." [11].

Fierst was obviously a devotee of astronomy for he went on to compare the relative merits of various telescopes around the world with an eye towards determining which would be the most suitable lens for his proposed space station. He favored the Yerkes Observatory telescope designed by F. E. Ross which "cuts off the diffusion of long streaks of light (for example, the fuzziness of cometary tails) in photographic images not near the center of the parabolic mirror." But its real use, as far as the rocket [i.e. the space station] is concerned," he continued, "lies in its ability to extend the accurate center of field of the telescopic mirror to three times its diameter, thereby increasing the size of the field of vision nine times." Fierst also noted that "perhaps the best solution of the rocket telescope" was the promised development of the "electronic telescope [sic], which will be smaller, simpler, and much more powerful than [those of] . . . modern observatories. . ." The electronic telescope will depend upon the amazingly sensitive photo-electric cell in the lens." Fierst also turned his attention upon observations of the Earth from space (presumably with telescopic photography). Vast improvements in cartography are suggested, as well as weather observations: "Tornados, rainstorms, ships in distress . . . will come under his [the astronaut's] field of observations . . . and the location of dense cloud formations will be radioed to the proper stations." However, it is implied that Earth weather observations could be made without the aid of a telescope and by the naked eye [12].

American Interplanetary Society member L. C. Lee, Jr. described (also in the Society's *Bulletin* for March-April 1931) his design of an "experimental atmospheric rocket" (Figure 2). This was not a space vehicle but an unmanned high altitude research rocket with a 50 to 200 mile (80 to 320 km) capability. Lee recommended the U.S. states of Arizona or New Mexico for the experiment, because the air there "is generally clear and dry. . . Hazy conditions in the atmosphere due to excess water vapor would be fatal to our photographic hopes." Lee could not provide any details of the rocket's propulsion "as none of the experimenters will give their findings on new fuel combinations." He therefore assumed that the vehicle would be propelled by a solid-fuel motor, and that the whole would weigh 180 lbs (80 kg) [13].

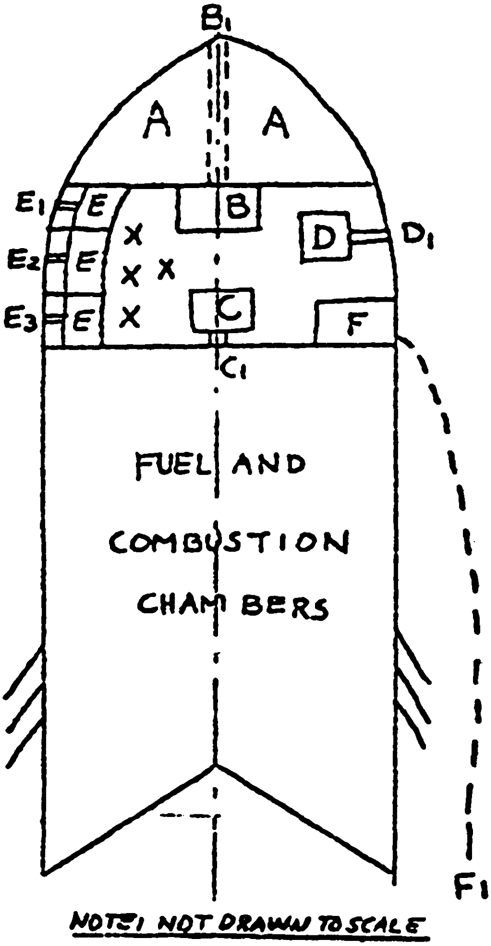



**Figure 2** Schematic of Experimental Atmospheric Rocket, with camera apparatus, designed by L. C. Lee, Jr., February 1931. Presented to the American Interplanetary Society, February 1931. The rocket was fitted with cameras and other instruments and was designed for 50-200 mile altitudes. Section A-A is for parachutes; B, for an electrically-operated camera; C, for another camera; D, for the thermometer; E, for air pressure and air chemistry recording instruments; E, $E_3$, etc. for air collecting devices; and $F_3$, a radio (From: **Bulletin of the American Interplanetary Society** (N.Y.), No. 8, March-April 1931, p.12).

Lee concentrated mainly upon the instrument package. This consisted of, besides the folded parachute section (A), two movie cameras (B and C) run electrically by storage batteries and activated by timers. The upper mounted camera (B) was to record pictures of the Sun during the rocket's ascent, while the lower mounted camera (C) took photos of the Earth's surface during the descent. Both B and C were standard airplane type cameras, electrically-driven and taking 4 x 5 in. (10 x 12.7 cm) images. It was planned that camera B would snap a photo of the Sun every two seconds, "since the rise [of the rocket] will be so rapid." Camera C was programmed to take a picture every minute for the first hour of the descent which, according to Lee's estimations, "will take in all about two and a half hours." Thus, C would not operate until peak altitude was reached and descent was about to begin.

At that point, an electric timer triggered the ejection of the nosecone from the rocket body. Simultaneously, the parachute flared open, slowly floating down the nosecone, which also cleared the lens of camera C, which would then begin filming. Camera B shut off [14].

Lee specified that the cameras use panchromatic film and 2 X or 3 X Wrattan filters to reduce haze and afford correct color values. The lenses were to be of quartz, which would protect them from "terrific changes of temperature." Lee further protected the cameras by means of insulation against cold "to prevent sticking." "We should thus get fine telescopic photographs of the Sun without atmospheric interference, and photos of our Earth, using a wide-angle lens, showing an area up to 200 miles by 400 [320 km by 640 km], or 80,000 square miles [205,000 square km]." [15].

Lee's experimental atmospheric rocket was also equipped with a thermometer for recording outside air temperatures by means of a revolving drum apparatus, air pressure recorders, and evacuated tubes for automatically collecting air samples throughout the rocket's descent. In addition, a silver disk pyrheliometer was suggested for recording the intensity of the Sun's radiation. Lastly, the nosecone section carried a lightweight shortwave radio, which served the double purpose of transmitting a constant radio signal for tracking the rocket and also unraveling the then mystery of the Heaviside layer of the upper atmosphere. Needless to say, Lee's estimates for the performance of his rocket, especially the descent time of two and a half hours, were gross miscalculations, but, in other respects, namely the photographic and other equipment, were remarkable anticipations of some later upper atmospheric sounding rockets such as the Aerobee and Viking vehicles [16].

In the same issue of the *Bulletin of the American Interplanetary Society* is found member Nathan Schachner's suggestion of a light compact motion picture camera as instrumentation of a space rocket, but he did not elaborate upon it. Noteworthy was Schachner's recommendation that the instrumentation include "a table type spectroscope with superimposed comparison spectra," one of the earliest suggestions for this particular class of optical instruments for use in a spacecraft. Schachner also dwelt upon a 5 in. (12.7 cm) refracting telescope imbedded into the quartz windows of the ship, but he did not mention a camera in conjunction with it [17].

In the following year, 1932, the Russian experimenter Vladimir V. Razumov designed a similar though less ambitious rocket than that of the American L. C. Lee, Jr. (Figure 3). Razumov completed this design in his capacity as the head of the Project Design Section of the Leningrad Group for the Study of Reactive Motion (LenGIRD). The proposed rocket was capable of climbing to an altitude of 10 km (6.2 miles), and was propelled by a series of four pyroxylin (doublebase) solid fuel units mounted around the forward part of the rocket. Four sweeping parabolic fins and an internal gyroscope linked to the rudders stabilized the rocket. The overall body length was 1.35 m (4.4 ft), and the diameter 0.25 m (0.8 ft). The launch weight was 26 kg (57 lbs), and the fuel weight 6 kg (13.2 lbs). The combined motor thrust was 270 kg (170 lbs) for 4.33 sec. The camera was to weigh 5 kg (11 lbs). The stated purpose of the camera was "to obtain a photographic record of the rocket ascent, by measuring a base line on the ground, which the rocket photographed from a specified altitude." This was a cartographic reference point since the draft of Razumov's project was prepared for the Leningrad branch of the Research Institute for Geodetics and Cartography (delivered 23 January 1932). The camera was placed in the rocket's nose, and was to be ejected when the vehicle reached its ceiling, then automatically took pictures during the estimated 50 second parachuted descent. Evidently, this was meant to be a reusable rocket for cartographic missions, but there is no evidence it was ever constructed [18].

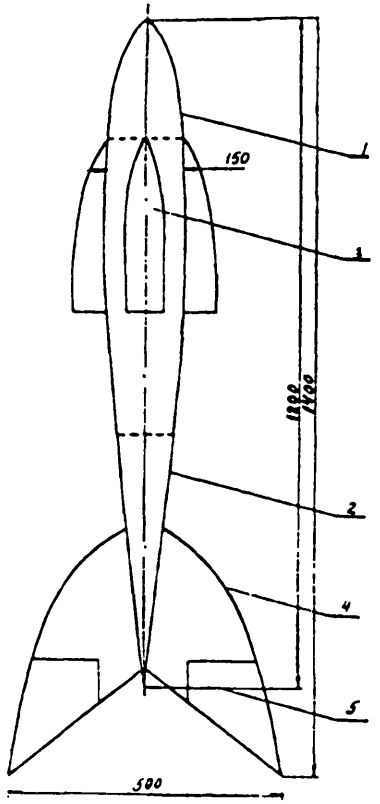



**Figure 3** Photographic (camera) rocket proposed by Vladimir V. Razumov, U.S.S.R., in 1931. Shown is: (1) the detachable nose carrying the camera; (2) the body; (3) forward section; (4) stabilizers; and (5) rudders. Pyroxylin smokeless powder was to have been the propellant and the climbing range was calculated at 10,000 meters (From: N. D. Anoschenko, ed., **History of Aviation and Cosmonautics**, NASA TT F-11, 427, Vol. I, 1967, p.21).

During the same period, another Soviet rocket experimenter, A. I. Polyarny, and his co-workers in Moscow designed the R-05/G (variant of the R-05) stratospheric rocket for the Geophysical Institute of the Academy of Sciences of the U.S.S.R. The original R-05 was meant for a 50 km (30 mile) altitude capability, so it is assumed the R-05/G was designed with a similar performance in mind. The R-05/G consisted of a solid fuel booster with a liquid fuel second stage. The initial weight without the booster was 55 kg (120 lbs). Among the payload was the FTI-5 miniature camera designed and manufactured on the order of "Design Office No. 7" by the Leningrad Optical Institute. There were also two barometers, a non-inertial thermometer, accelerometer, pressure gauge for measuring engine pressures, and a miniature radio-transmitter. The camera was to record the Earth's surface upon descent. But, as with Razumov's project, the R-05/G probably never materialized [19].

From Germany in 1936 came the most unusual mode of launching a camera to high altitude. This was the design of a combination ramjet-liquid propellant rocket booster. The design was the idea of rocket pioneers Rolf Engel and Franz Mengering who prepared the drawing, dated 14 March 1936, and was stamped "Geheim" ("Secret"), because, according to the recollections of Engel, they wanted to apply for a patent on the concept but wished to "avoid any unwanted distribution." Later on, continues Engel, we "dropped this project because at that time the general knowledge about ramjets was not well enough developed. During 1940, I had an exchange of these ideas with Dr. Eugen Sänger, who was a specialist on ramjets in Germany. But the combination of ramjets was technically not possible at such an early stage of development." No details are known of the camera or its mission, other than that it is shown in the drawing as being mounted at the very tip of the nosecone [20].

As early as 1928 came the first known experiments with flying camera rockets for upper atmospheric investigations. These were undertaken by the Austrian Friedrich Schmiedl, who was acclaimed more for his achievements with mail rockets. The camera experiments can only be briefly outlined. They were extensive, but because Schmiedl worked under economic hardship, the rocket and much of the equipment were crude, yielding only low contrast photos and limited scientific results. Schmiedl sought to produce low cost "recording rockets" for a variety of photographic missions. "To avoid every unnecessary gram of load," he recalled, "I developed and built tiny cameras. Only a few grams in weight. These were intended for extreme altitudes. There were no tiny photographic objectives to be had anywhere. I was unable to grind the lenses myself, and also I did not know how to calculate photographic objectives. It was for this reason that I used individual cemented lenses made from Zeiss (Jena) microscope objectives that could be obtained anywhere, 'DD' middle lens, Zeiss (Jena), 'E' middle lens, and Reichert '7a' (middle lens). Such microscope lenses of older types were obtainable cheaply." (Figure 4). Since 1927, Schmiedl had been a member of the Graz, Austria, Amateur Photographer's Society and had the opportunity to construct his small cameras in the Society's laboratory as well as to do "pertinent experiments." Apart from the financial considerations, Schmiedl also favored micro cameras, because of his friendship with Professor Pregl Fritz, the founder of microchemistry. "So I was especially familiar with the techniques and apparatus of miniature type, and I built them quite small for my rockets too." The cameras themselves were small cardboard boxes with holes for the lenses and sun shields and solid pieces of black paper serving as the shutters. These were connected to small spiral springs, which cocked and closed the shutters. The rockets, also constructed by Schmiedl, were propelled by a solid propellant of his own formulation (possibly gunpowder or potassium chlorate based). The bodies were of cardboard with clay inserts [21].

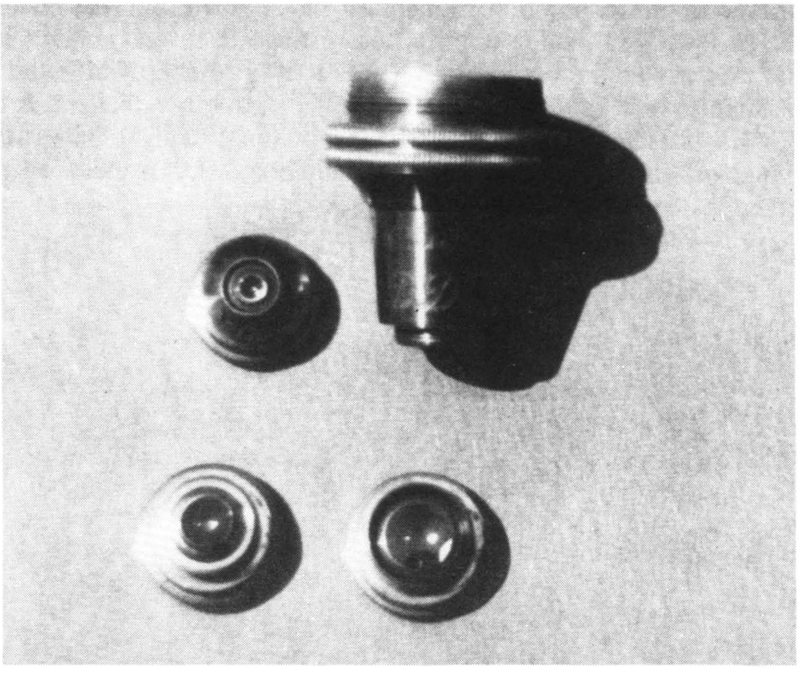


**Figure 4** Middle lens, DD, of a Zeiss microscope, as used by Friedrich Schmiedl to construct a miniature camera for his camera rocket, 1931, also called the "Registrier-Raket" (Register Rocket) (Photograph from Friedrich Schmiedl, Graz, Austria).

Most of Schmiedl's photographic rocket experimentation was conducted between 1931 and 1934. One of these "recording rockets" was designed to make reliable land surveys from low altitudes. Possibly connected with this were Schmiedl's experiments with rocket cameras fitted with green and other filters for more easily distinguishing different types of vegetation, such as lime, oak, beach, hornbeam and other trees. He found that with the right combination of filters and negative and positive film the different trees could be more easily identified than with the naked eye. The vegetation pictures were taken by a camera descending by parachute after ejection from the rocket. Schmiedl therefore came close to anticipating remote sensing photography from satellites to determine the health of crops and other vegetation.

Schmiedl also made a number of cloud observation photos by means of rockets (Figure 5). These included experiments with stereo or pseudo-stereo views made with double lensed cameras in attempts to obtain three-dimensional images of the clouds. In arid times, when clouds were absent from the sky, Schmiedl created his own by seeding the atmosphere with chemicals to form ice crystals. On 21 April 1931, and subsequent dates, Schmiedl attempted to take spectrographic or ultra-violet photos of the Sun by his rockets. The rocket on the former occasion weighed 20 kg (44 lbs), and was therefore much heavier than usual. He admitted, however, that the resulting pictures were not sharp. Apparently, he also tried launching a rocket with a small Pathé movie camera, but the camera was still too heavy, and the rocket overturned. He proposed to the Ufa (Universum Film, AG), or Universal Film Corporation, that they finance his project to launch a rocket with a movie camera from a high altitude balloon to increase the rocket's altitude, but the company turned him down. Schmiedl had other interesting ideas, but money was always a problem, particularly as the worldwide Depression more deeply affected Austria, and his experiments were soon discontinued. In India, another mail rocketeer, Dr. Stephen H. Smith of Calcutta, attempted two flights on 17 July 1940 with his own camera-carrying rockets (in this case, commercially bought), but these were only in the nature of stunts, and in any event, ended as failures [22].

**Figure 5** Enlargement of a typical cloud photograph taken by one of Friedrich Schmiedl's camera rockets in the 1930s.

Decidedly more scientific was Karl Poggensee, a young electro-mechanical student of Germany's Hindenburg Polytechnikum in Oldenburg. A radio amateur since 1922, Poggensee designed and built a sleek aluminum-bodied 3.5 m (11.5 ft) tall rocket weighing 13 kg (28.6 lbs) and carrying recording instruments, which included a camera, an altimeter, an instrument for measuring the rate of speed, and a radio transmitter to help track the rocket. There was also a device which mechanically determined air pressure in the rocket, and transmitted this data by radio. The rocket was propelled by a solid propellant of Poggensee's own make, the propellant charge weighing 5 kg (11 lbs). Recalled Poggensee years later (Figure 6), "My rockets were to fly to the stratosphere to photograph the ground and at the same time to test the propulsion system as a 'flying rocket test stand'. . . The camera was made very lightly to save on propellant." A clockwork timer activated the camera. The timer was triggered by a taut wire, which was anchored to the ground prior to launch. As the rocket ignited and rose, the wire was yanked away from the rocket, thereby pulling the timer switch which apparently also triggered the transmitter (power for the transmitter came from two flashlight batteries). Little is actually said of the camera, except that its lens jutted from the rocket body and was aimed toward a slanted mirror on the side of the rocket, so that a picture could be taken of the ground at the rocket's peak altitude. The objective lens was infinity, and the shutter speed, 1/25 sec. On 13 March 1931, the rocket was launched from level ground near Berlin (Figure 7). It reached about 1,500 ft (460 m), according to its recovered altimeter.

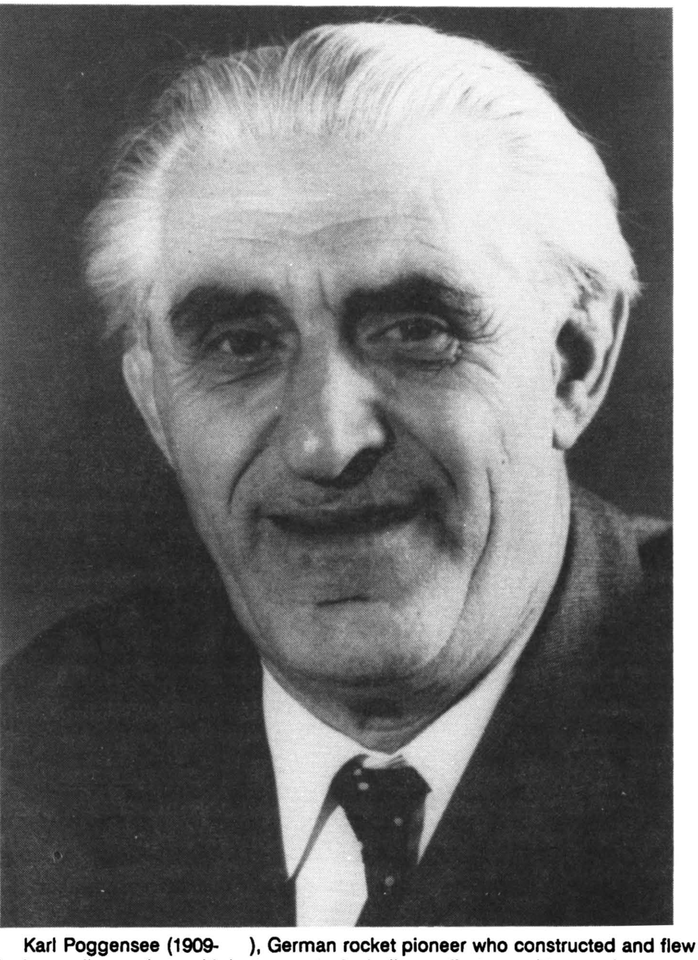


**Figure 6** Karl Poggensee (1909- ), German rocket pioneer who constructed and flew solid-fuel sounding rockets with instruments, including radio transmitters and cameras, circa 1930-1931 (Photograph taken in 1973).

The experiment was well publicized, though the photo taken of the ground does not seem to have been published. During the war this photo was lost. But apparently there were additional flights, as Poggensee says: "This camera was flown many times . . . [and] was lost in an accident with the rocket." Poggensee continued his propulsion experiments in search of greater lifting power for his camera. This research included hybrid solid propellant-liquid fuel systems. There were evidently both technical and financial problems attending these, and Poggensee was led to abandon his experiments altogether. In addition, from about 1933, the German government discouraged all private rocket research, though Poggensee later found employment at Germany's secret army rocket test center at Peenemünde [23].

**Figure 7** Camera rocket prior to flight, being held by its designer and constructor, Karl Poggensee, at Oldenburg, Germany. The rocket burned a solid-propellant and was constructed in a nearby fireworks factory. In the center of the rocket, above Poggensee's head, is seen the camera mechanism. The lens was thrust out of the body of the rocket and aimed towards a slanted mirror and thereby took pictures of the ground. Poggensee is shown holding a wire with his left hand. This wire activated the clockwork timer for the camera; one end of the wire is connected to the timer within the rocket and the other end anchored to the ground. As the rocket was ignited, the wire was pulled within the rocket which set the timer (Photograph from Karl Poggensee).

The worsening worldwide economic situation of the Depression affected many rocketeers of the 1930s. By 1935, the international astronautical movement had noticeably declined, although Germany's clandestine and well-financed military rocket program was well under way, with Peenemünde opening in 1936. The V-2 wonder weapon eventually emerged from Peenemünde. Following the war, this same rocket was fitted with cameras and opened up another new chapter in capturing photographic images from the fringes of outer space.

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