# History of Rocketry and Astronautics

Proceedings of the Twenty-Fourth Symposium of
the International Academy of Astronautics

Dresden, Germany, 1990

J. D. Hunley, Volume Editor

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## AAS History Series, Volume 19

A Supplement to Advances in the Astronautical Sciences

## IAA History Symposia, Volume 11

AAS Publications Office
P.O. Box 28130
San Diego, California 92198

Affiliated with the American Association for the Advancement of Science
Member of the International Astronautical Federation

*First Printing 1997*

ISSN 0730-3564

ISBN 0-87703-422-2 (Hard Cover)
ISBN 0-87703-423-0 (Soft Cover)

Published for the American Astronautical Society
by Univelt, Incorporated, P.O. Box 28130, San Diego, California 92198

Printed and Bound in the U.S.A.

# Chapter 12

# Alfred Maul: A Pioneer of Camera Rockets*

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## Introduction

Several reports about rockets before World War I have been presented in these congresses, but only one of those reports is written about nonmilitary applications of the rocket.[1,2] Alfred Maul's rockets, however, were planned for military reconnaissance.

Incomplete and contradictory statements about A. Maul and his experiments induced me to make concrete inquiries. Extensive investigations for years in archives and libraries, and contacts by letter and in person with Maul's descendants, contributed to presenting the life and the work of Maul as a monograph at this congress. Maul was often named in an erroneous context, or reports about his experiments were incorrect. Regarding the period of time of his experiments with rockets there are also differences of opinion.[1-6] The source of these inaccuracies was the book of Max Valier *Raketenfahrt*, which is the fifth edition of *Vorstoß in den Weltenraum*, to which later authors refer.[7]

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* Presented at the Twenty-Fourth History Symposium of the International Academy of Astronautics, Dresden, Germany, 1990.

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Alfred Hermann Carl Maul was born on November 27, 1870, in Poessneck, (Thuringia), as a son of the trader, Carl Ernst Julius Maul, and his wife, Ottilie Christiane Regina. After attending the social school in Poessneck and Dresden he graduated from the Conservatory of Dresden and the Engineering School in Reichenberg (today [1990] Liberec, Czechoslovakia). Maul was both an excellent piano player—he had so-called absolute hearing—and a very good engineer (Figure 1).

**Figure 1** Alfred Maul, 1910.

In 1895, Maul received a trading license as a mechanic for electrical installations. He opened a technical office and occupied himself with the construction of counting, dosing, filling, and packing machines for the pharmaceutical and chemical industry, and for the cigarette factory in Dresden. His extensive work is revealed by 22 patents in mechanical engineering. From 1931 on, he started to produce his products in his own engineering works. In 1900, Maul married Selma Marie Meyer. They had three children. The civil engineer, as noted in the address register of Dresden, suffered from diabetes in his last years. This led to the amputation of both legs. He died on August 27, 1942, of his illness.

## Period of Experiments

Max Valier writes that Alfred Maul had launched his first model of a camera rocket in 1904.[7] Other sources also give 1903 or later.[2,4,6,20] Difficulties in the stabilization of the rocket and the release of the shutter are said to have arisen. The parachute system is also said not to have met expectations. These facts, described by Valier, cannot be agreed to. On June 5, 1903, Maul already applied for his first patent: "Rocket apparatus for taking photographs of definite areas." (see patent section a at the end of this paper).

The inventor described the prevention of the rocket from turning by the use of guides (in German "Führungsflächen"), today called stabilizing fins. This patent shows two variants: In one drawing the wings are directly on the rocket; the other one shows a rocket with a guidestick (Figure 2). At that time, the problem of stabilization was settled by Maul.

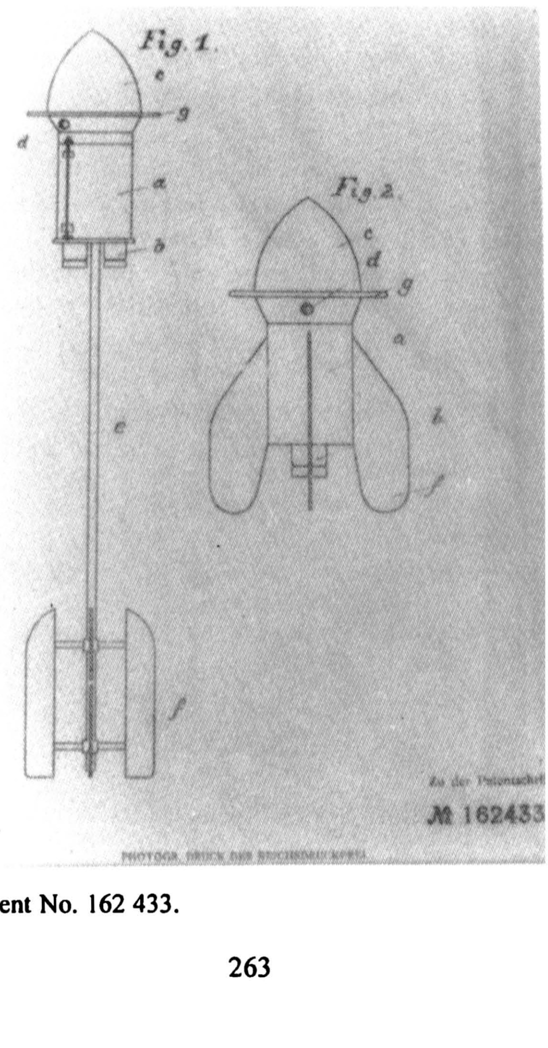



**Figure 2** Patent No. 162 433.

Maul began with his first tests in the spring of 1901.[13] In the beginning several complications appeared. Once the parachute did not work; next time the rockets exploded, and then the camera shutter did not release, or it released at the wrong moment. The theoretical considerations were made in about 1900. This assumption is supported in an article of 1914.[10]

Therefore, the period of time of the experiments can be fixed between 1901 and 1912. There are no proofs of experiments after 1912, as mentioned in several publications.[10-13]

## The Rocket Apparatus

An analysis of Maul's patents, photographs, drawings and descriptions in the literature proved that he constructed nine apparatuses and built at least six of them. He changed the form of the rockets permanently to find the ideal type of construction. Striking, as well, is the variation of the wings, which are the basic requirement for a stable flight position and, thus, influence decisively the quality of the photographs. As wings, Maul used a framework of pipes covered at the ends with cloth (Figure 3).

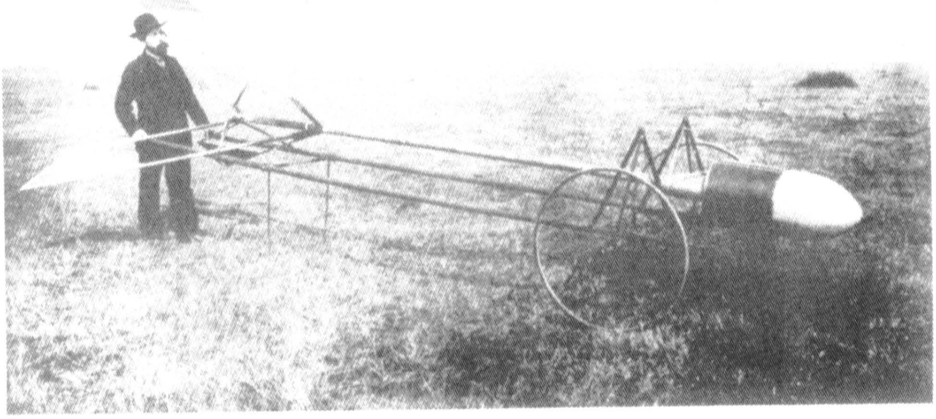


**Figure 3** One of Maul's rockets in 1903.

Succeeding construction had smaller wings made of wood. So he stopped the rotary motion. The wings were put at a guidestick in the cruciform. The first models were 3.9 m long, and later ones were 6 m long. Thus, Maul reached a transfer of the center of gravity and, with that, better flight stabilization. The inventor used lifesaving rockets like boosters.

The last rockets of Maul were driven by solid propellant of the Pyrotechnical Laboratories in Berlin-Spandau. As the use of only one solid booster brought unsatisfactory results, on following models he used two parallel boosters. Now the rockets reached their highest point of 600 to 800 m in 6 to 8 sec with double propulsion.

Shortly before the zenith was reached, the pneumatic-electrical contact released the camera shutter and the parachute mechanism. After the opening of the parachute, the rocket separated into two parts. Directly on the parachute hung the nosecone box with the camera. The box consisted of a wooden frame, covered with pasteboard, and it was painted blue or red. Below the box hung the body of the burnt-out rockets and the guidestick on a cord approximately 10 m long. Thus, a considerable portion eased the parachute on touching the surface, and the camera could come down slowly and shockfree.

Maul even occupied himself with the stabilization of the rocket in the phase of descent. In the patents 177884 and 191259, several possibilities are described (see patent sections d and e at the end of this paper). On the one hand, wing-shaped areas should counteract a bank caused by wind while ascending. On the other hand, Maul used a kind of reversed umbrella, after having used the parachute system, which was to open up after reaching the zenith. Maul wanted to make the taking of photographs possible in the descent phase (Figures 4, 5 and 6).

Maul tried, several times, to stabilize the rocket during flight by means of variation of the wings, and after unsuccessful experiments he had the idea of using a gyroscope for a stable flight position.

It is known that the effect of a rotating gyroscope is to stabilize the direction of flight. This method we still find today in spacecraft and satellites. It is possible that Maul was the first to use gyroscopes for stabilization.

The gyroscope was set in motion by a falling weight, which released an electrical ignition. Figure 7 shows that two little gyroscopes and a big wheel realized a stable flight of the camera rocket. This technique allowed high precision in the ground areas to be photographed.

Maul changed the position of the camera several times. From this resulted, for example, a changed position of the opening of the objective in the nosecone of the rocket, where the camera was put. For instance, he put the axle of the camera objective into the axle of the movement direction of the rocket.

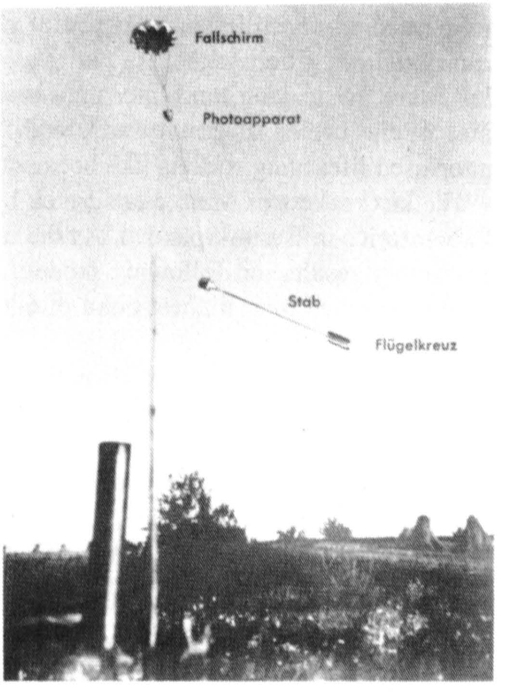



**Figure 4** Rocket on reentry.

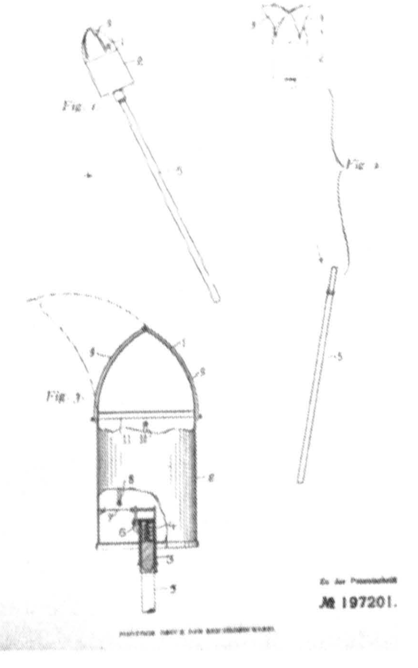
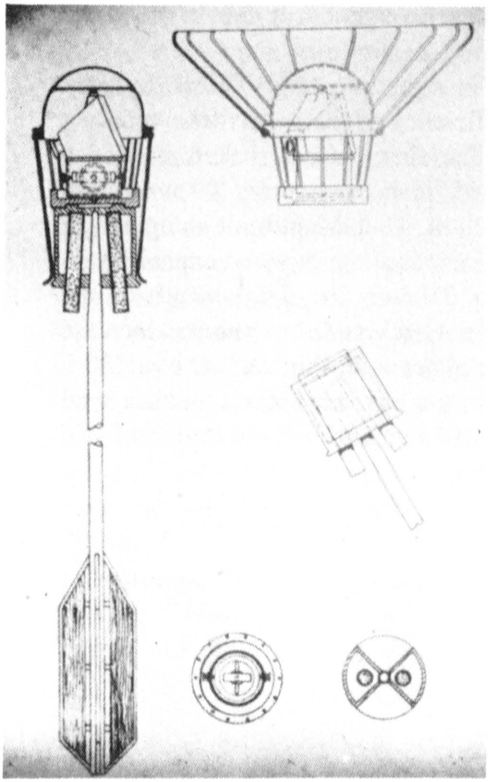
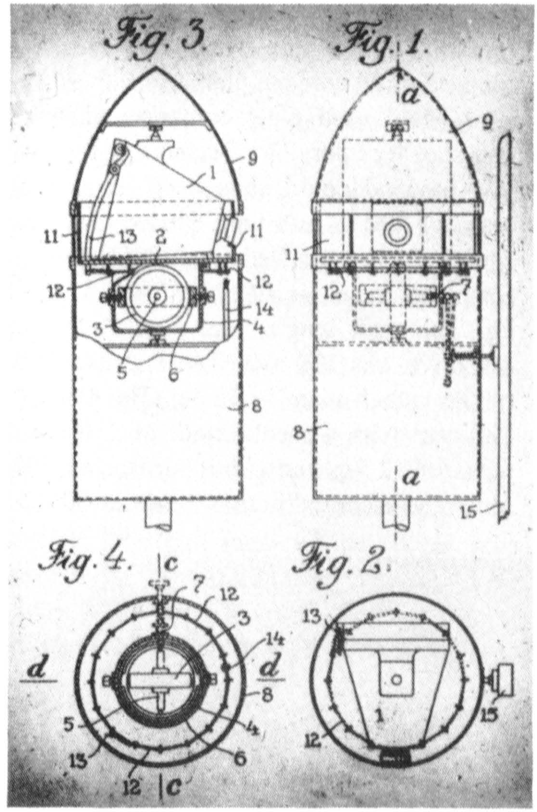



**Figure 5** Patent No. 197 201.





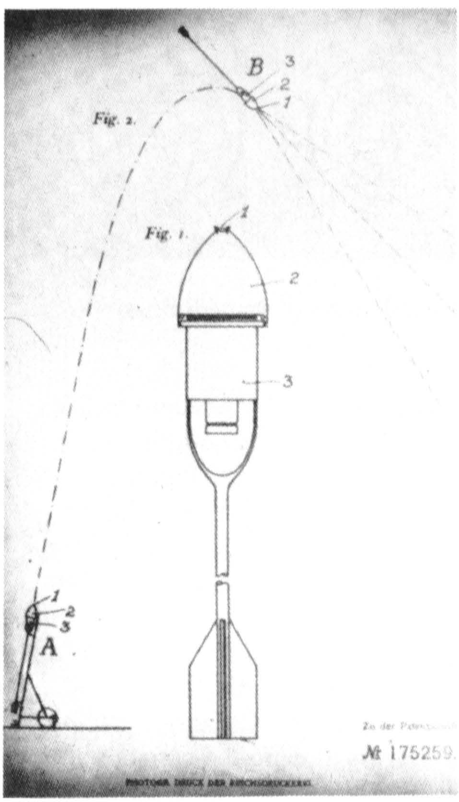

**Figures 6 and 7** Rocket with "umbrella" (left); drawing of shutter release with a fuse (right).

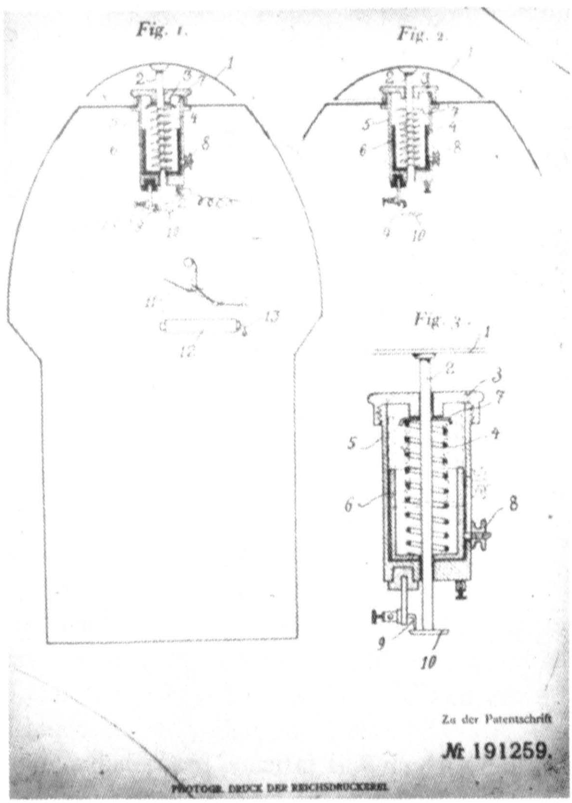
With this, arose the demand for releasing the shutter after having reached the zenith, that is, at the time when the rocket returned to Earth with the top in front during the turn back to Earth to photograph the assigned area (Figure 8).

In the experiments which are known, the release of the shutter took place shortly before, or directly upon, reaching the zenith, so that the objective of the camera was directed at an angle down. An analysis of the camera position proved that the optical axle was sloped at an angle of 75 degrees to the movement direction of the rocket. Thus, it was possible to portray an area from a distance of 2,200 to 3,400 m in great detail, while ascending vertically.

The area to be photographed could have been chosen by a target tracing sight which was fastened to the launching platform. By sloping the carriage, the optical angle to the vertical could have been varied. Thus, it was possible to take photos either of nearer of more distant areas. Theoretically there could have been a picture taken at 80 km. The visual angle that could have been used was 50 degrees. By the stabilization, as described earlier, Maul achieved a maximal rotation of 1 degree, which meant a tolerance divergence of 0.6 m from the focused middle of the picture.

Maul used plate cameras exclusively in experimenting. Therefore, only one shot was possible. Because of the low efficiency of the solid rockets, only a low payload could have been transported. The first camera rockets carried a mass of 200 g, and they carried a camera with plates measuring 40 x 40 mm. This specimen reached an altitude of about 300 m. Then Maul built an apparatus for plates measuring 120 x 120 mm, and he increased the payload capacity to 6 kg. The total length was 4 m, the diameter 21 cm. The focal length of the objective was 120 mm. The improvement of the rockets led to another increase of the launch mass to 25 kg. The size of the plates with this variant was 180 x 180 mm with a focal length of 210 mm. The last camera rockets, with a total mass of 42 kg, had plates measuring 200 x 250 mm and a focal length of 280 mm. The ascent altitude was about 600 m.[13]




**Figures 8 and 9** Patent No 175 259 (left); Patent No 191 259 (right).

Maul had several variants of mechanisms for shutter release patented (see patent sections c and g at the end of this paper). One version was the release by means of a time fuse. This principle worked as follows: a tightened spring was connected with a fuse, which burnt out at the very moment when the rocket reached its zenith. The spring was relieved, the camera shutter released and the plate exposed. (Figure 9).

Maul devised another possibility by using the existing air pressure from the ascent of the rocket. In doing so, a plate on the top of the rocket was to press down a spring and, thus, interrupt an electrical contact. On reaching the zenith with an air pressure of 0, the spring was relieved and a contact shut. This actuated a mechanical bolt and, with this, the shutter.[13]

Maul used lifesaving rockets as boosters. At first he used solid rockets from the Groß-Feuerwerkerei Fischer from Weinböhla near Dresden. They managed, indeed, to draw a cord a short distance, but were the rockets able to carry a relatively heavy payload? As mentioned before, the first rockets could only carry a load of 200 g to an altitude of 300 m. Maul used a "double rocket."[14] That means two fixed boosters in parallel. The total mass of the rocket was 700 g. The larger models were powered by solid rockets from Pyrotechnical Laboratories in Berlin-Spandau. They were 55 m long, had a diameter of 8 cm, and were filled with 4.5 kg of powder. The rockets reached their zenith of 600 m in 6 to 8 sec.

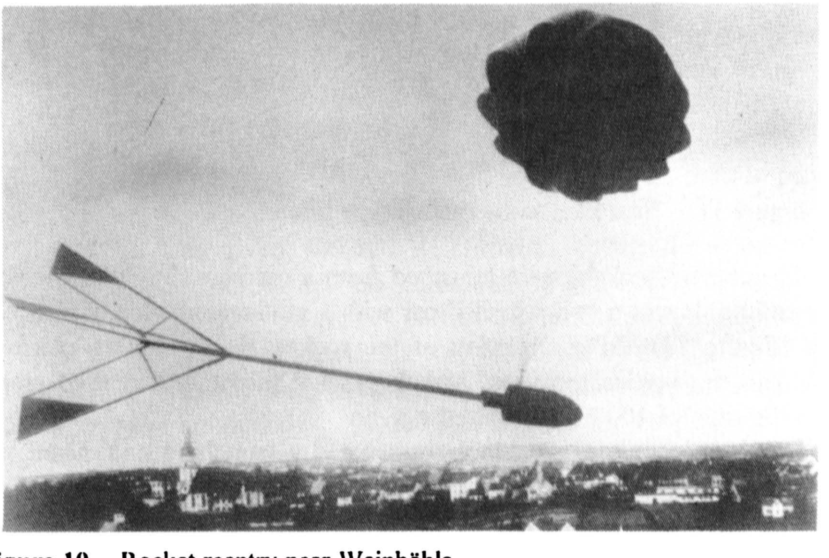


**Figure 10** Rocket reentry near Weinböhla

The first rockets were equipped with a rigid, almost 2 m long, guidestick, which stayed connected with the rocket body during the landing (Figure 10).

After exposure of the plate, the later rockets separated into two parts. Directly at the parachute, the nosecone hung with the camera, and on a 10 m long cord the "service unit" with the guidestick.

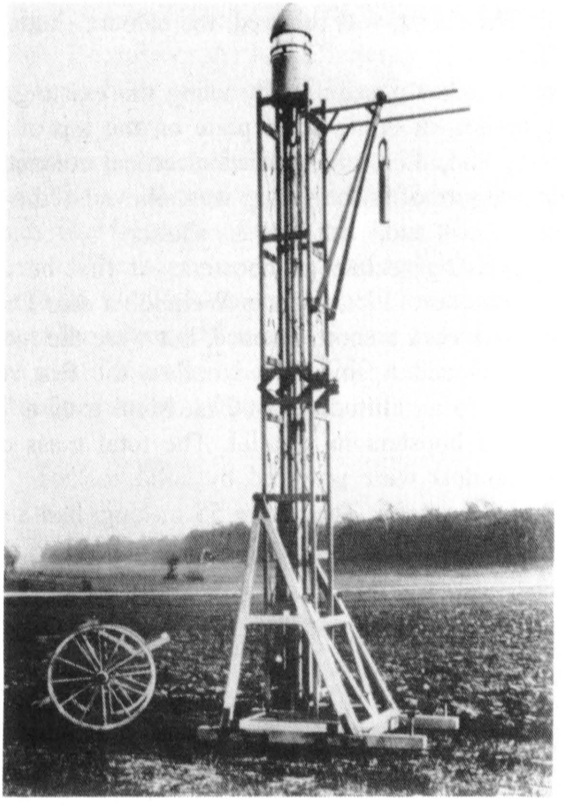


**Figure 11** The rocket in the carriage.

The camera rockets were launched from a carriage. Initially this was relatively simple. It was a two-wheeled car with a guidance device, which was able to tilt (Figure 11). After insertion of the rocket, the launching platform was returned to the vertical position, and the rocket motor was ignited electrically from a distance of 100 m.

For the bigger rockets, Maul constructed a launching pad. Maul wrote in 1915:

> For launching the rocket the 400 kg weight carriage is used, on which the target equipment is located. On marching, the carriage is folded up and put on a wheel-car, which also carries the boxes with rockets. If the apparatus is to work, the carriage will be driven to the launching point and put up. Then

the direction of the area to be photographed will be determined by means of the target equipment (rotating sight with scale). After that the assembled rocket is pushed into the horizontal carriage, and the optical axle of the camera is adjusted to the direction which was determined before. A flag near the launching platform indicates the wind direction.

Now a heavy weight is hung on the cord being wound around the axle of the gyroscope, which winds up the gyroscope device, and the carriage is put vertically. Thus the rocket is ready to be launched.[13]

The carriage could be folded and was 7.5 m high. As already described earlier, the rocket was now launched. Some minutes after the landing, the photos were ready to be analyzed.

According to his own notes, Maul started with his first experiments in the spring of 1901, in Weinböhla near Dresden. Weinböhla, in the literature, is also called Niederau. It is a village near Weinböhla, and is also located at the line Dresden-Riesa-Leipzig. In 1903, Maul could already launch his first rockets from the military place near Königsbrück, to the north of Dresden. Officially his experiments were reported in August 1906, and the invention was judged useful by the military. Even the King of Saxony was present at one of the experiments.[12] To demonstrate the invulnerability of his rockets, compared to balloons, 120 infantrymen are said to have shot at the landing apparatus without doing any harm to it.

On October 20, 1906, Maul presented his camera rocket "in the presence of 30 officers near Berlin."[13] Possibly this took place on the former firing range of Berlin-Reinickendorf, where Rudolf Nebel founded the Raketenflugplatz, Berlin, later.

Indeed, several articles contended that a factory should be built to produce the camera rockets in Weinböhla, but it was never realized.[13,14] It was also reported that Maul was given 400,000 Reichsmark for the development and building of the rockets. About that his comments in an article: "The sentence before the last is invented!"[14] A greater part of the funds for building the rockets was raised by the inventor himself. He was supported by the family of industrialist Hultzsch of Dresden and, occasionally, by military departments.[19] The costs are said to have amounted to 100,000 Reichsmark for the period of experimentation. Although the amount of 70 Reichsmark for a rocket was low in comparison to the price of a balloon, a production line was not set up.

## Importance and Meaning of Maul's Experiments

Several sources point out that ideas of rocket photography already existed before the experiments of Maul. However, there is no evidence of practical experiments before 1901. Therefore, Alfred Maul was the first who actualized the idea, and who, furthermore, devoted himself extensively to the problem of rocket photography. So to speak, he initiated the prephase of remote sensing with high-altitude rockets, and thus he is the pioneer of rocket photography. The following achievements can be ascribed to Maul:

- First practical use of rockets for remote sensing,
- Return of payloads to Earth and repeated use of the rocket body,
- Use of gyroscopes for stabilization of rocket flight.

Maul wrote some short articles for newspapers and journals which deal with this problem. The article "Die Rakete als Treibmittel" (The Rocket as Propellant), documents that Maul dealt intensively with propulsion technology. In the article he describes the structure and the efficiency of solid rockets.

Maul did not write more important treatises about his experiments with camera rockets. His technical solutions are documented in the patents. Possibly he was the practician more than the theoretician.

Maul's rocket experiments, which he stopped after 1912, did not gain in significance. One reason was probably the introduction of photography from aircraft, where it was possible to take several photos at once by using the roll film camera. On the other hand, at that time the advantages of Earth photography could not have been estimated.

The idea of the camera rocket was resumed with the first experiments of German liquid rockets in the 1930s. This is verified by the fact that Maul was invited, by Wernher von Braun, to the Versuchsstelle Kummersdorf, near Berlin, at the beginning of the 1930s. But the idea still did not reach a practical fruition.[12]

The inventions of Maul had no influence on the process of rocket development and its application. The value of the achievement of the pioneer of rocketry can only be judged by knowing the developments of remote sensing via satellites. Maul's camera rockets must be ranged in the line of inventions which were created long before their practical use.

**Figure 12** Photo of Laussnitz was taken with Maul's camera rocket.

## Patents

a. Patent Nr. 162 433, Klasse 57a:
Raketenapparat zum Photographieren bestimmter Geländeabschnitte vom, 5. Juni 1903 (Rocket apparatus for photographing certain segments of land, from June 5, 1903).

b. Patent Nr. 175 259, Klasse 57a, Gruppe 7:
Verfahren zum Photographieren vorher bestimmter Geländeabschnitte in schräger Richtung aus der Luft mittels eines photographischen Apparates, dessen Objektivachse in der Achse der Bewegungsbahn der Vorrichtung liegt vom 30. März 1905 (procedure for photographing previously determined segments of land in an oblique direction from the air by means of a photographic apparatus whose lens lies in the axis of the device's path of motion, from March 30, 1905).

c. Patent Nr. 177 884, Klasse 57a, Gruppe 32:
Vorrichtung zur Auslösung einer Sperrung bei drehbar gelagerten Instrumenten, insbesondere zur Auslösung des Verschlusses einer drehbar in einem Gestell gelagerten photographischen Kamera vom 23. September 1905 (Device for clearing an obstruction by pivoting instruments, especially for release of a shutter in a mounted photographic camera, from September 23, 1905).

d. Patent Nr. 191 259, Klasse 57a, Gruppe 32:
Vorrichtung zum Auslösen einer Sperrung an in der Luft getriebenen Apparaten bei Erreichung einer bestimmten Geschwindigkeit, insbesondere zur Auslösung des Objektiv verschlusses photographischer Apparate vom 29. August 1906 (Apparatus for clearing an obstruction in a device propelled into the air by reaching a certain velocity, especially through release of the instantaneous shutter of a camera, from August 29, 1906).

e. Patent Nr. 197 201, Klasse 57a, Gruppe 7:
Verfahren und Vorrichtung zum Senkrechtstellen von photographischen Apparaten o. dgl. enthaltenen Raketengeschossen mit Führungsstab vom 23. Februar 1907 (Procedure and apparatus for vertical placement of a camera or the like in a rocket with guide stick, from February 23, 1907).

f. Patent Nr. 210 303, Klasse 57, Gruppe 7:
Verfahren und Vorrichtung zum Photographieren nach einer bestimmten Richtung mittels eines in die Höhe getriebenen photographischen Apparates vom 23. Januar 1908 (Procedure and apparatus for photographing in a certain direction by means of a camera propelled to a high altitude, January 23, 1908).

g. Patent Nr. 210 369, Klasse57a, Gruppe 7:
Vorrichtung zum Photographieren mittels eines in die Höhe getriebenen, auf bekannte Weise in eingestellter Richtung gehaltenen Aufnahmeapparates vom 28. Januar 1908 (Apparatus for photography by means of a camera propelled to high altitude [and] held in a fixed direction in a recognized manner, January 28, 1908).

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[15]*Ebtal-Abendpost*, 20. Mai 1908.
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