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## Chapter 14

# Relevant Analysis of the Innovative Conrad Haas Manuscript from 1555\*

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### Abstract

Dumitru Todericiu's 1961 discovery, in Sibiu (formerly Hermannstadt), of the now-famous manuscript of Conrad Haas, which was produced in Hermannstadt in 1555 and includes the earliest known manufacturing data on rockets, fireworks, and munitions in the Middle Ages, has remarkably changed the view of the beginnings of rocket propulsion in Europe. Haas is believed to be the first person to describe a multistage rocket in writing. Until 1961, the oldest known European document on rocket manufacturing was *The Great Art of Artillery, Part One*, written by Lithuanian Casimirus Siemienowicz. It was published in 1650 in Amsterdam, and thereafter in Paris, Munich, London, Copenhagen, and Warsaw.

The Sibiu discovery has, however, pushed the beginnings of rocket history and European priority on the concept of rocket staging one century earlier, as a genuine description of an original rough concept of small, staged, powder rockets is surprisingly revealed in the Haas manuscript. This chapter will analyze as far as possible, based on the manuscript itself, the undoubted originality of the de-

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scription involved, at least through a comparison of the Haas manuscript with the much later one of Siemienowicz. This comparison reveals that perhaps the Siemienowicz work is based on the Haas manuscript, in regard to the very important innovation of rocket staging. The matter is important because, despite a considerable number of proposals for rocket application, no earlier Asian—particularly Chinese—manuscripts have promoted any ideas regarding rocket staging in general. As far as astronautics itself is concerned, the Haas manuscript extends to a much earlier date the concept of rocket staging, and it is fascinating to see the process of the birth of this technical concept. The creation of such a professional and detailed manuscript was, in fact, a courageous enterprise, because there is speculation that the later Lithuanian author paid with his life for his intention to publish the second part of his manuscript.

## **Introduction**

This chapter presents some interesting new aspects regarding the rocketry manuscript of Haas, which was produced in Hermannstadt in 1555. This manuscript came to light in 1961, when it caught the attention of Todericiu, the father of coauthor Alexandru Todericiu, in the public records of Sibiu, Romania (formerly known as Hermannstadt).<sup>1,2</sup> Called the *Kunstbuch* (Manual of Techniques), more than two-thirds of the 282-page manuscript is dedicated to rocketry and includes the earliest known information on the manufacture of rockets, fireworks, and munitions in the Middle Ages. The ideas put forward in this work appear to be those of Haas himself, and they have remarkably changed the view of the beginnings of rocket propulsion in Europe. Haas is now believed to be the first person to describe a multistage rocket in writing.

### **Conrad Haas (~1509–1576) and His Description of Austrian Medieval Rocketry**

The Haas manuscript reveals the work of a man who was probably the most innovative early European thinker in rocketry. He was a military engineer and a commissioned officer in the Artillery Corps of the Imperial Court of Vienna.

Conrad Haas was born in Dornbach, now part of Vienna, but his family originated from Landshut, Bavaria. Around 1529 he moved to Transylvania, an area at that time known as Siebenbürgen (Seven Forts) and part of the Austrian Empire, but now part of Romania. Haas became the commander of the artillery

barracks at the arsenal at Hermannstadt (modern Sibiu). Here he wrote, between 1529 and 1555, what is now the earliest known European handbook of rocketry. This work, written in German, included pioneering drawings of, among others, the multistage rocket principle and preliminary designs for delta-shaped fins. A strikingly similar work is a later 1650 publication from Simienowicz.

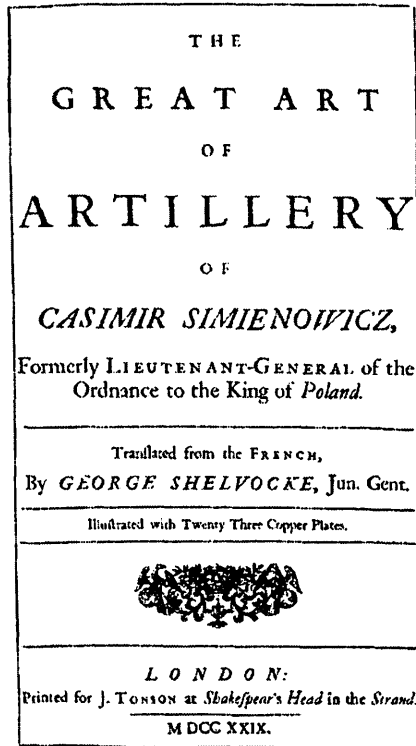


**Figure 14–1:** Conrad Haas ~1509–1576. Credit: artwork by G. Deutsch, reproduced from B. P. Besser, “Austrian Space and Rocket Pioneers,” *Preparing for the Future* Vol. 10, No. 2 (August 2000): p. 26.

### **The Widely Published Manuscript of Casimirus Siemienowicz (~1600–~1651)**

Until the discovery of Haas’s work in 1961, the oldest known European document on rocket manufacture was *Artis Magnae Artilleriae, Pars Prima* (*The Great Art of Artillery, Part One*) written by Siemienowicz. It was originally written in Latin and published in 1650 in Amsterdam.

The Siemienowicz book is illustrated with 23 copperplate illustrations of extremely high quality for the time, showing a painstaking attention to detail. Many of the illustrations are strikingly similar to those of Haas, including the multistage rocket, delta fins, et cetera.



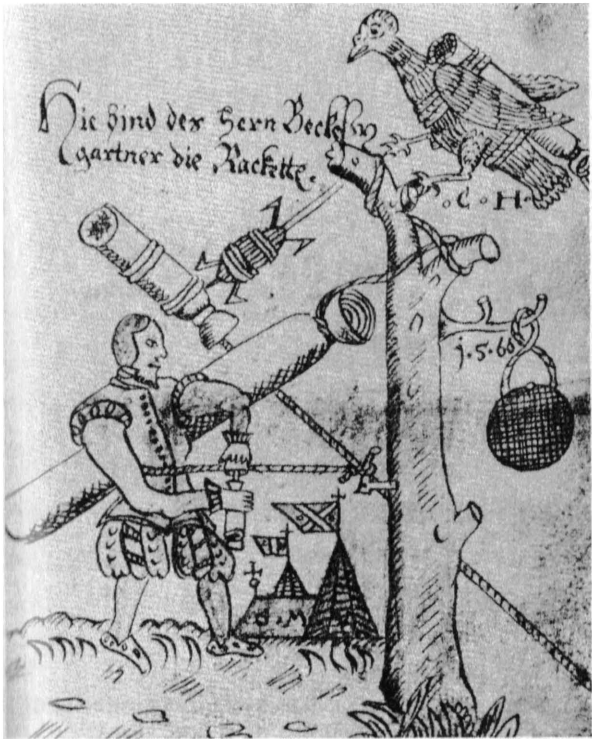
**Figure 14–2:** Title page from the 1719 English edition of Siemienowicz’s work. It is a translation of the French edition, originally published in Paris in 1657.

Siemienowicz’s year of birth is uncertain, and his place of birth is disputed (because of a scarcity of evidence) to be in Lithuania or Belarus.<sup>3</sup> After a wide-ranging military career, in 1648 he served as second commander of the Polish Royal Artillery. In 1649 he moved to the Netherlands, where he spent a year writing *The Great Art of Artillery, Part One*. There are various rumors about his last days: some say that he wrote the second part of his book in manuscript, before his death, and that he was killed by members of the weaponry guild, who strongly opposed the publication of their secret manufacturing technology, ensuring that the second part was destroyed.

### **Some Excerpts from the Manuscript of Haas, 1555**

Figure 14–3 is an illustration from Haas’s *Kunstbuch*, depicting various tools and techniques for rocket manufacture. Its title in the manuscript translates as “How You Must Make Quite a Nice Rocket That Can Travel (Propel) Itself into the Heights (Heavens).” The illustrations show that the way in which a wet,

softened paper tube (later dried), is constricted with a cord to shape a nozzle, is an ancient technology, that has remained unchanged until today in fireworks manufacturing, due to both reliability and easiness of the method. The extensive use of a weighing scale, especially for attaining the correct proportions of the components of the black powder propellant, is suggested by the weight hanging on the tree branch. One wonders about the “rocket-powered bird” drawn on the top of the tree: was it meant to represent an actual experiment, with the hapless bird as an early precursor to the Soviet Union’s space dog, Laika, in 1957? One can only imagine what sort of fate would have befallen it!\* There are also signs of a crude, clumsy attempt at perspective drawing, with the church in the background as the most prominent building of the town.

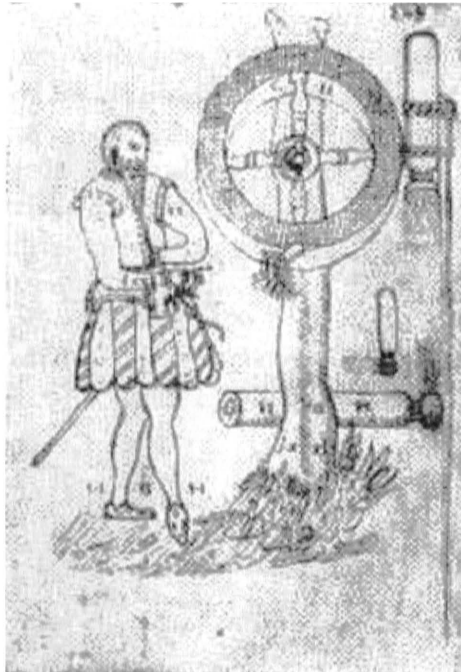


Conrad Haas (1529 – 1569), „Königlicher und Kaiserlicher Zeugmeister“ in Hermannstadt. Entwurf, „Wie du solt machen gar schöne Rackette, die da von im selber oben hinauff in die hoch faren“.

**Figure 14-3:** An illustration from the Haas manuscript, depicting the tools and techniques of rocket manufacture.

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\* Editor’s Note: Or does it represent a European version of the Chinese “flying crow with heavenly fire,” which used a model bird, powered by firework rockets, as a “terror weapon” in battle against enemy forces?



**Figure 14-4:** Illustration from the Haas manuscript showing a rocket stabilized by a long guidance stick and a “reaction wheel” suspended from a tree.

In Figure 14-4 there is a paper-tube rocket stabilized by means of a long wooden stick. This “pendulum” type stabilization is a most reliable method for securing dynamic stability, still used today in firework skyrockets. Haas, however, also proposed the use of delta-shaped fins for stabilization (although ancient Chinese rockets are claimed to have been the first to use the delta fin).

One has to be careful not to exaggerate in extrapolating from Haas’s illustrations. The drawing of a reaction wheel (or Catherine wheel-type firework) attached to a poor Sibiu tree in Figure 14-4, has nothing to do with the eventual project of an orbital space station, as suggested by Wernher von Braun, despite their striking visual resemblance, yet it has been interpreted that this represents a space station concept.<sup>4</sup>

In both Figures 14-3 and 14-4, and in other illustrations in the Haas manuscript, a man is depicted who has been speculated to be Haas himself.

### **Comparing the Haas and Simienowicz Works**

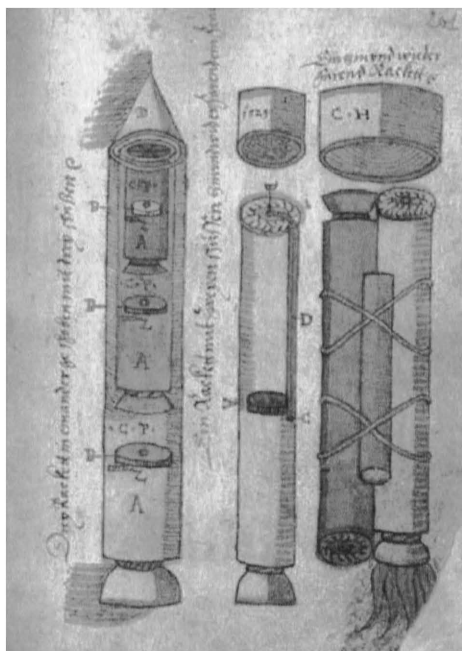
The striking similarity between the rocket diagrams from the works of both Haas and Simienowicz raises the question: was there a replication of Haas’s ideas



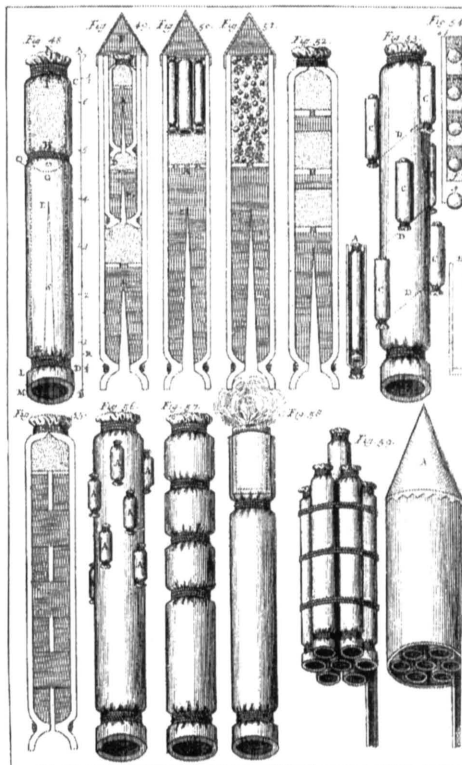
by the Lithuanian Simienowicz, or were the two men deriving their works from a common, more ancient ancestor which is still unknown. As the designs for the staged rockets in both involve identical technologies, and even identical “mistakes,” the latter hypothesis is quite plausible.

### Multistage Fireworks: A Haas–Simienowicz Comparison

Next is a comparison of two illustrations on identical subjects from the Haas manuscript and Siemienowicz’s *Great Art of Artillery*:



**Figure 14-5:** Illustration from Haas showing designs for multistage and bundled rockets.



**Figure 14-6:** Siemienowicz illustration showing designs for multistage and bundled rockets.

Figure 14-5 presents Haas’s original illustration showing a multistage rocket. In this drawing, Haas uses the terminology *Schlygen* for “stages,” a word replaced today by *Stufen* in German. The Siemienowicz version of the three-stage paper rocket (the drawing labeled Figure 49 within Figure 14-6) is a cross section, while the older Haas drawing is a meritorious attempt at perspective—a rude axonometry.

The description of the rocket construction is identical in both designs and comprises:

- a cylindrical thrust chamber filled with a pressed-powder propellant, with a conical hole to progressively increase the combustion area and consequently the thrust. Similar designs are manufactured today for commercial model rocket use;
- a nozzle with a bell-shaped divergence zone. However, the small expansion ratio does not justify such a solution, and the innovation could rather be related to the cord-constriction (*Klemmung*) technology (as shown in Figure 14–3);
- a discoid chamber head with a central orifice for igniting the explosive powder fuel;
- once ignited, the fast-burning, high granularity, powder fuel ignites the main propellant of the upper stage;
- However, no attention has been paid to the means of stabilizing the rocket's flight, either by using a stick or delta fins. Even supposing any of them to be present on the first stage, their presence is impossible on the upper stages, which will be unable to fly stably;
- Even if an unstable flight could be accepted for the second stage, it would be totally unacceptable for the third stage.

Rather than being seen as an incomplete resolution of the staging problem, perhaps the Haas–Simienowicz design may be better interpreted as a “staged combustion” concept, such as that first definitively outlined by the French inventor Louis Damblanc in 1937, with remarkably similar designs. All these designs show that no progress in the concept of staging was made up to the 20th century. The Haas–Simienowicz drawings represent a crude conceptual idea, and their similarity suggests that both are based on an older, still undiscovered original.

It should be noted that the manner of denoting the powder content is almost identical on both illustrations, with the uppercase letter “A” being used for the main propellant. The details of the Simienowicz drawing are a little bit more elaborate, with the aspect ratio of the device, in terms of outer diameters, being entered on left, although an absolute scale is not given.

### **Conrad Haas Celebrated Today**

A monument dedicated to the memory of Austrian rocketry inventor Conrad Haas, who made Sibiu his home city, was unveiled on 2 March 2010, in the enclosed yard of the Romanian Academy, with the attendance of many dignitar-

ies: the General Mayor of Bucharest, Sorin Oprescu; Deputy Mayor of Vienna, Renate Brauner; Martin Eichtinger, the Austrian Ambassador to Bucharest; former President of Romania, Emil Constantinescu; former cosmonaut Dorin (Dumitriu) Prunariu; a representative of the City Hall of Sibiu; the President of the Romanian Academy, Ionel Haiduc; and, from the faculties, Professor Dr. Eng. Radu Rugescu.



**Figure 14–7:** Unveiling ceremony of a monument dedicated to Conrad Haas, in the enclosed yard of the Romanian Academy on 2 March 2010.

“We are witnessing a renaissance of the true European spirit. Europe must become a single market of talent and cooperation between Romania and Austria,” pointed out Ambassador Eichtinger at the ceremony. The memorial was sponsored by Alexandru Todericiu, son of Dumitru Todericiu, discoverer of Haas’s manuscript in Sibiu.

## References

- <sup>1</sup> Sibiu public records, Varia II 374.
- <sup>2</sup> D. Todericiu, “Raketentechnik im 16. Jahrhundert—Bemerkungen zu einer in Sibiu (Hermannstadt) vorhandenen Handschrift des Conrad Haas,” *Technikgeschichte* 34, no. 02 (1967): pp. 97–114.
- <sup>3</sup> Tadeusz Nowak, *Kazimierz Siemienowicz, ca.1600–ca.1651* (Warsaw: MON Press, 1969), p. 184.
- <sup>4</sup> B. P. Besser, *Austria’s History in Space*, ESA Publication HSR-34 (The Netherlands: European Space Agency, 2004), p. 3.
- <sup>5</sup> B. P. Besser, “Contributions of Austrian Pioneers to Early European Rocketry,” AIAA Technical Paper 2001-0174 (2001), pp. 6–7.
- <sup>6</sup> H. Barth, *Conrad Haas—Leben und Werk in Wort und Bild* (Bucharest: Kriterium Verlag, 1983).