

N77-33031

ROMANIAN ROCKETRY IN THE 16th CENTURY⁺Elie Carafoli and Mihai Nita (Romania)⁺⁺

A mediaeval manuscript, recently discovered in Sibiu, a town in central Romania, was found to contain important new information on the development and construction of powder rockets. Handwritten in old German, the Sibiu manuscript is in the form of a "coligatum" with texts by three authors.¹ The last of these authors, Conrad Haas, served as the Chief of the Artillery Arsenal in Sibiu from 1529 to 1569; his portion of the manuscript, devoted to rocketry, is the subject of this paper.²

In comparing Conrad Haas' document with about thirty works on pyrotechnics of the time, either published or in manuscript form, D. Todericiu of the University of Bucharest judged the technical creation in the town of Sibiu, in the ensemble of European pyrotechnics, a valuable analysis of the mediaeval concerns in ballistics, pyrotechnics, and the construction of rockets. Written by Haas sometime between 1529 and 1569, his chapter "On rockets" in this manuscript describes the activity carried out in the construction of rockets in Sibiu by the author together with local pyrotechnists.

The value of the Sibiu manuscript resides in the information that it furnishes concerning a number of most interesting technical achievements, quite a lot of which have a character of priority in the history of the progress in rocket technique. Thus, the investigations undertaken in the past few years have confirmed the fact that the Sibiu manuscript is the oldest document known up to the present that contains references and definite data concerning the construction of multistaged rockets.

⁺Presented at the Third History Symposium of the International Academy of Astronautics, Mar del Plata, Argentina, October 1969.

⁺⁺Carafoli is President of the Commission on Astronautics of the Academy of the Socialist Republic of Romania; Professor, Institute of Fluid Mechanics, Bucharest. Biographical information on Nita is unavailable.

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In Figure 1 Haas gives the sketch of a double rocket--which would be called nowadays a "two-staged rocket." The operating principle of this rocket is fairly similar to the manner in which a two-staged rocket is conceived to work nowadays. At first the charge of powder in the first engine is ignited and provides the propulsion for the rocket (the ensemble of the two engines, together with the payload). Once the first stage stops working, the flame is conveyed to the propellant in the second engine which provides additional propulsion of the rocket. It is of interest to note that in this sketch the separation of the first stage is not necessary. Haas provided for the integral consumption of the first engine while the propellant burned. To this end, he made the rocket cover out of paper impregnated with various substances which burned as the propellant was consumed in such a way that, when the first stage was exhausted, the second engine remained on the trajectory as an independent entity.

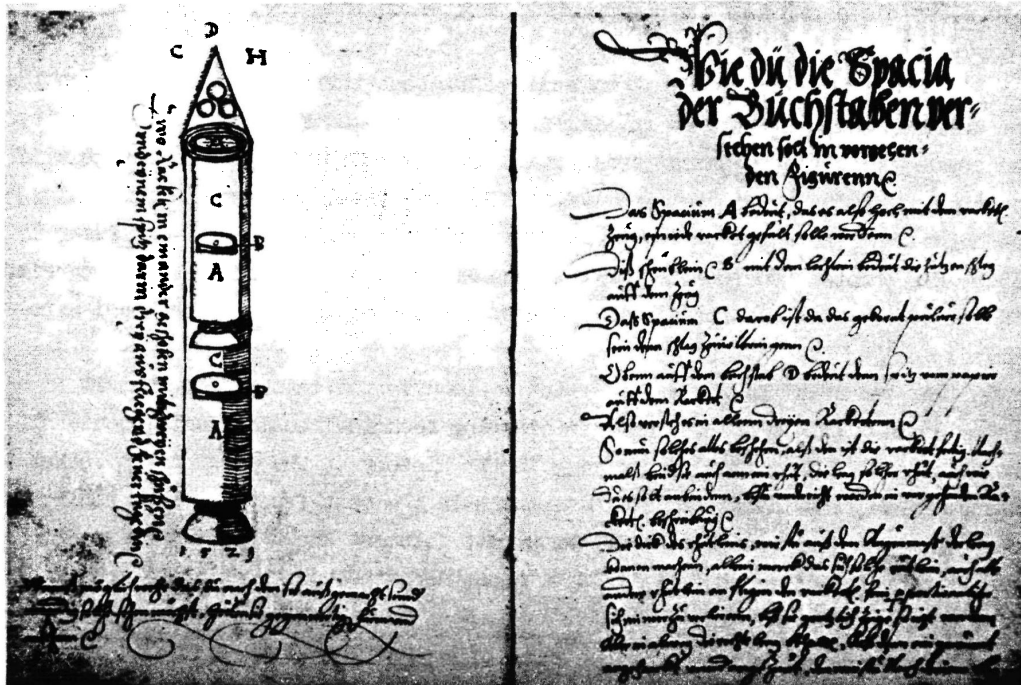


Fig. 1

The successful experiments performed with such rockets led Haas to the construction of a three-stage rocket (Figure 2). The operation of this rocket was similar to that of the two-staged rocket. Another result of the technical thought in Sibiu at the beginning of the 16th century was the testing of the possibilities of transporting to a certain distance, with the aid of rockets, a powder barrel which would explode on returning to earth (Figure 3).

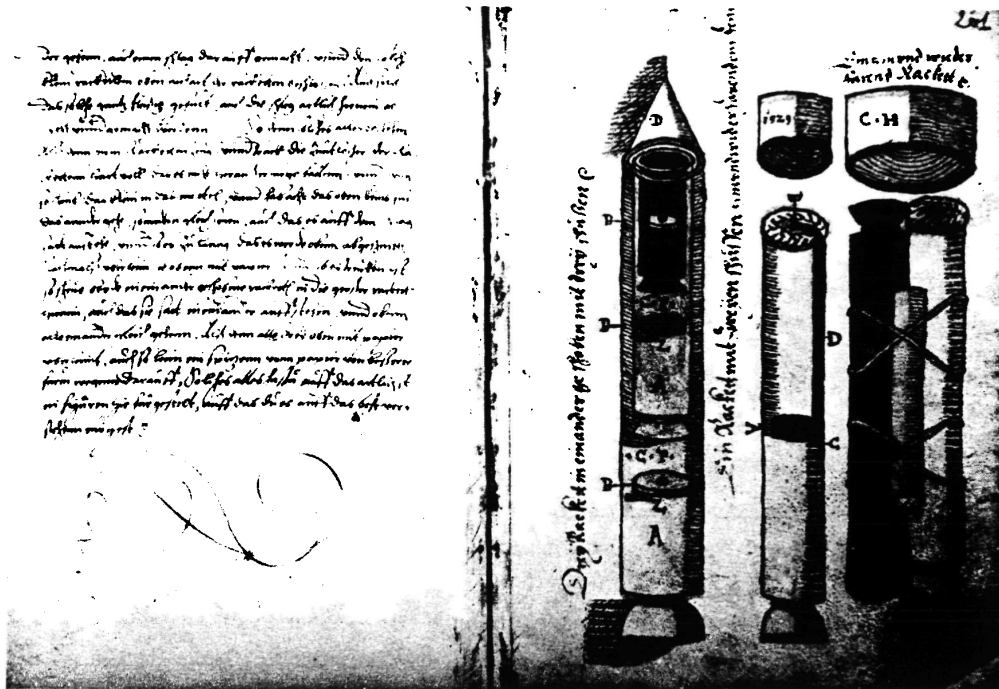


Fig. 2

Apart from extending the range by using a rocket system with successive ignition, interesting solutions for obtaining guidance and flight stability are to be noticed. One can readily see that the solutions Haas adopted were somewhat more advanced than the old Chinese "fire arrow." We can see in the photo that, according to the conception of the Sibian pyrotechnists, the rocket possessed the same main elements as any modern rocket: the body of the rocket, the payload, the propulsion system, and the stabilization system in the shape of a swept-back tail.

As a matter of fact, it is with surprising clearness that the idea of using the rocket as a means of conveyance appears in the manuscript. Figure 1 shows the front end of the rocket beneath the cover of which lies the payload, represented by

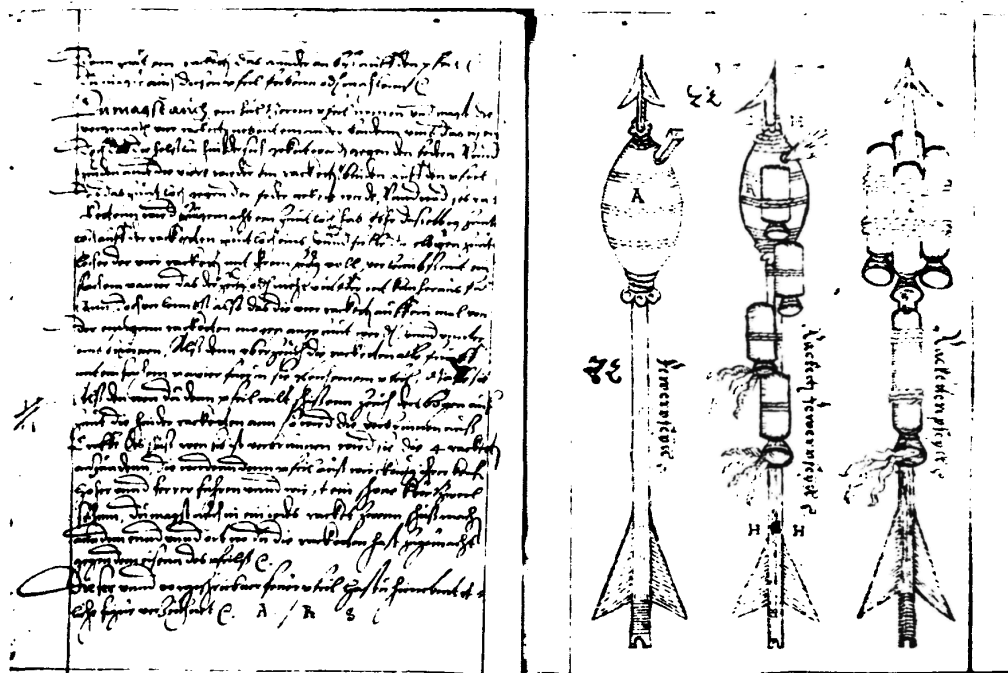


Fig. 3

three balls. One may perceive the similarity between the solution adopted four centuries ago in Sibiu and the mode used nowadays for carrying any load by means of rockets.

The pages of the manuscript also reflect the existence of valuable experience in the field of pyrotechnics taken over from local handicraftsmen, both in the domain of the manufacture of powder and its ingredients. Thus, Haas described the methods used by the Romanian natives in Transylvania for obtaining saltpeter and for manufacturing a coal that could provide a controllable combustion of the powder. Here Haas mentioned the recipes worked out by the well known pyrotechnist Hanes Walach, of Romanian descent, a specialist whose name is to be met with in the historical documents belonging to the end of the 16th century and mentioned in older studies of highly-reputed Romanian historians (such as Nicolae Iorga and C. C. Giurescu). Hanes Walach (in translation, John the Romanian) had perfected five powder recipes, called at that time "hard powder," out of which one was said "to burn just as water runs," that is, very steadily.

Along the same line of ideas, we should mention the stellar form of the powder grain adopted for many of the rockets described in the manuscript which is very much like the combustion surface of solid propellants used at present. The use of the

experience of the local handicraftsmen for obtaining the ingredients of powder, and particularly of the reputed experience of John the Romanian, accounts for the fact that Conrad Haas developed his ideas in Sibiu, in Transylvania, carrying out his activity there for over 40 years, from 1529 to 1569. The Sibian manuscript represents an actual vade-mecum of the rocket technology. Apart from the data pointed out above, it also includes numerous details concerning the construction of each constituent element of the body, tests and various experiments of jet-propelled technique, the judicious distribution of the propellant in the rocket stages, etc. Haas' activity and the influence he exerted found a powerful echo in other authors, both contemporaries and successors.

In chronological order, Haas' work appeared before the creations of several famous authors, such as Biringuccio (Venice, 1540), J. Schmidlap (Nürnberg, 1561), L. Fronsperger (Frankfurt, 1557 and 1566) and Kazimir Siemienowicz (Poland, 1650). The analysis of their works and of those written by other authors, compared to Haas' text and drawings, emphasizes similarities and ideas that were taken up again, thus reflecting the flux of ideas between contemporaries and their successors. In view of this, Sibiu of 1529 represents a starting point in the history of the modern rocket. Numerous specialists in the history of rocket technology, as for example Professor Dr. Subotowicz, Professor René Taton, and Professor Dr. Friedrich Klemm, agree to this position which has restored Haas in the history of multi-staged rockets.

Unlike all the other military engineers of his time, Haas and his collaborators were constantly preoccupied with rocket technique, and particularly with the peaceful application of rockets. The drawing in Figure 4 is significant in this respect, it is the image of a little flying house atop a rocket, and can be interpreted as Haas' naive prefiguration of the idea of future manned space flight.

Haas concluded his manuscript with the sentence: "But, my advice is for more peace, not war." That sentiment conveyed over centuries will perhaps find its fulfillment in contemporary society, and thus meet the hopes of all mankind.



Fig. 4

REFERENCES

1. Registered in the National Archives at Sibiu under the title Pars Arhivi Civtas Cibiensis - Varia II 374.
2. A further elaboration of the Haas work can be found in D. Todericiu, Preistoria rachetei moderne (Prehistory of the Modern Rocket). Bucharest: Publishing House of the Romanian Academy, 1969.