

**IAC-02-IAA.2.P.01**

**Luigi Gussalli – Italian Spaceflight Visionary**

Michael L. Ciancone  
NASA Johnson Space Center

Diana Motta Rubagotti  
Fondazione Civiltà Bresciana

**53<sup>rd</sup> International Astronautical Congress**  
**The World Space Congress – 2002**  
**10-19 Oct 2002/Houston, Texas**

*For permission to copy or republish, contact the  
International Astronautical Federation, 3-5 Rue Mario-Nikis, 75015 Paris, France*

**LUIGI GUSSALLI**  
**Italian Spaceflight Visionary**  
**(1885-1950)**

Michael Ciancone<sup>1</sup> and Diana Motta Rubagotti<sup>2</sup>

Abstract

The purpose of this paper is to heighten awareness within the space history community of the contributions of Luigi Gussalli, an Italian inventor and spaceflight visionary.

---

<sup>1</sup> NASA Johnson Space Center, Houston, Texas 77058, USA <amorea@prodigy.net>

<sup>2</sup> Fondazione Civiltà Bresciana, 25122 Brescia, Italy <dianamot@tin.it>

## Introduction

Luigi Gussalli was a solitary inventor and spaceflight visionary. His most enduring legacy is his primacy as the author of the first Italian book of speculative non-fiction on human spaceflight in which he proposes the use of his “double-reaction” motor for interplanetary spaceflight. He refined his ideas in later books and introduced the idea of using solar radiation for powering the motor and as a direct means of interplanetary propulsion. Although contemporaries acknowledged his passion and imagination, they were almost universally critical of the technical soundness and practicality of his ideas. Nonetheless, the infusion of new ideas was certainly a useful stimulus in the developing field of astronautics.

The Fondazione Civiltà Bresciana, Brescia, Italy (directed by Monsignor Antonio Fappani) maintains the Gussalli archives, which are available for scholarly research. The Fondazione Civiltà Bresciana recently published *Luigi Gussalli – pioniere dello spazio* (Brescia, 2002), edited by Giovanni Caprara.<sup>3</sup> The book includes reprints of Gussalli’s published works, with English translations, as well as articles discussing the life and work of Gussalli.<sup>4</sup> This paper makes generous use of information provided by the Fondazione Civiltà Bresciana.

Special thanks to Mrs. Mirella Ughi Corda for her recollections as a family friend and secretary to Gussalli during the last ten years of his life.

## The Life of Luigi Gussalli

Luigi Gussalli was born in Bologna, Italy, on December 18, 1885, to Odoardo Gussalli and Adele Rosetti. He spent his youth in the town of Brescia, where he later conducted most of his study and research. Gussalli studied physical sciences and math at the Engineering Faculty of Parma (Italy) and physics at the University of Pavia before graduating from the Polytechnic

<sup>3</sup> Editrice “Fondazione Civiltà Bresciana”, via S. Giuseppe 5, Brescia, Italy 25122 <info@civiltà-bresciana.it>

<sup>4</sup> These articles, with partial English translations, are “The Ideas, Accomplishments, and Projects of Luigi Gussalli, the First Italian Pioneer of Astronautics” by Giovanni Caprara; “Luigi Gussalli, a Life Between Imagination and Technology” by Diana Motta Rubagotti; and “Luigi Gussalli, Inventor – From the ‘Ippomobile’ to the Assault Tank; From Stereoscopia to the Stratospheric Airship” by Franco Ragni.

School of Glons-Liége, Belgium in 1909 with a degree in Industrial Engineering.

[insert photo of LG]

In May 1915, Gussalli enlisted in the Italian Army as a volunteer driver (Second Lieutenant). He was initially assigned to the 9<sup>th</sup> Fortress Artillery Regiment (no longer as a volunteer), which was active in areas of hostility. However, he requested a transfer to a less active zone and was reassigned to Dell’Erra Foundry in Novara and the Wenviller Works in Romagnano Sesia where he carried the title of “engineer” and was involved in the development of different types of grenades and a prototype assault tank. Gussalli eventually attained the rank of Captain.

## Inventions

Gussalli was an innovator in many fields. Although his ideas were plentiful, he failed to meet with much success in developing these ideas into practical applications. Among his inventions were the following concepts, some of which resulted in prototype hardware, while others never left the drawing board:

- a form of *mobile advertising*, in which ads placed on public transport would automatically and regularly change
- *rifle silencers*, which Gussalli claimed to have constructed and tested in 1907
- the “*ippomobile*,” a horse-powered cart in which a horse, fitted with rubber shoes, ran on a treadmill inside the cart, which in turn provided locomotive power to the vehicle; a prototype was built in 1910 and publicly exhibited, but never commercially developed; Gussalli’s 1923 book contains a chapter on this invention
- a *lounge sleigh* that incorporated wheels on a sleigh
- a *snow sleigh* powered by a motor-driven propeller
- an *assault tank* that relied on a complicated system of skates rather than caterpillar tracks
- a *rifle-launched grenade*; Gussalli’s 1923 book contains a chapter on this invention
- an *amphibious automobile* that employed two engines (one for use on land, the other for use in water) which never progressed beyond concept

- a system for *direct stereoscopic vision*; Gussalli's 1923 book contains a chapter on this invention
- a *perforated grill for sunbathing enclosures*, much like solar screens in use today, was patented in the U.S. in 1928
- *boat landing skates* that would allow a boat to land on the beach
- a *stratospheric airship* that would use a solar thermal energy system for propulsion
- a *system for neutralizing magnetic mines*

[insert photo of ippomobile]

Gussalli participated in a number of international exhibitions. In September 1923, he exhibited at in the International Exposition of Inventions and Industrial Progress in Torino, Italy. He also exhibited at the Paris Fair of 1931 and displayed photos of some of his inventions at the 3<sup>rd</sup> International Patent Exposition in Philadelphia (Feb 1932), the 4<sup>th</sup> International Patent Exposition in New York (May 1932), and the Chicago Worlds Fair Patent Show (June 1933). He used these opportunities to present his work on double-reaction motors, which he used in the design of "the first rocket-automobile constructed in the world (1912)."

Recognition of his work was not limited to international venues. Gussalli was nominated for the Knight of the Order of the Italian Crown in 1933. In 1939, he received an award for participating in the Exhibition of Leonardo da Vinci and Italian Inventions.

#### His First Book

In 1923, Gussalli wrote *Si può già tentare un viaggio dalla terra alla luna? – Relazione di esperienze eseguite coi propulsori a doppia reazione*<sup>5</sup> [Is it now possible to attempt a voyage from the Earth to the Moon? – results of experiments conducted on double-reaction propulsion]. In this booklet, which also covered his work in other areas, Gussalli analyzes the requirements for undertaking a manned trip to the moon and back and proposes the use of a double-reaction motor for propelling a vehicle consisting of a series of smaller vehicles [essentially, a multi-stage rocket]. The last vehicle of this "rocket train" would contain the

<sup>5</sup> Milano: Società Editrice Libreria, 1923. In Italian. A rough English translation appeared in *Quest – The History of Spaceflight Magazine*, Spring, 1995, pp. 30-34.

crewmembers and the propellant needed for the return to Earth. Gussalli also addresses the logistical needs of the crewmembers (e.g., food, oxygen, and thermal environment) and suggested that the vehicle be rotated about its axis to generate a gravitational environment.

[insert image of book cover]

In this book, Gussalli proposes using a rocket engine system that incorporated a "double-reaction motor" to augment the thrust from the high-speed exhaust of a rocket. He apparently conceived this idea in 1912 since he refers to it as the "Gussalli 1912 System." The exhaust from a rocket would be directed onto the blades of a turbine which, driven by its own independent motor, would provide supplementary energy to the rocket thrust. Gussalli attempted to demonstrate the feasibility of this approach using a steam generator and a steam-driven turbine mounted on the chassis of a motorcar, but he encountered problems during testing that caused the turbine to perform inefficiently and limited the results of his tests.

[insert image of double-reaction motor]

[insert photo of test setup]

Gussalli had difficulty getting his book published. He was initially rejected by a number of publishers before the Società Editrice Libreria agreed to publish, provided it was done at the author's expense. This was similar to the experience of Hermann Oberth and David Lasser when they attempted to publish their first books in Germany and the U.S., respectively.<sup>6 7</sup> Gussalli was unsuccessful in subsequent efforts to publish his book in Germany.

He sent copies of his book to other researchers around the world, including Nicolai Rynin (Russia), Guido von Pirquet (Austria) and Robert Esnault-Pelterie (France).<sup>8</sup> Esnault-Pelterie provided Gussalli with a detailed analysis of his proposal, which he later included in his encyclopedic work *L'Astronautique*.<sup>9</sup> Although

<sup>6</sup> *Die Rakete zu den Planetenräumen* (Munich: Oldenbourg, 1923). In German.

<sup>7</sup> *The Conquest of Space* (NY: Penguin, 1931). This was the first technical book in English on the use of rockets for spaceflight.

<sup>8</sup> Gussalli was obviously aware of the work of Esnault-Pelterie and Goddard, whom he references in his book

<sup>9</sup> *L'Astronautique* (Paris: Lahure, 1930), pp. 75-78.

Esnault-Pelterie was critical of Gussalli's proposal, he offered regrets and indicated that this should not detract from recognition of his efforts. Rynin also mentions Gussalli's work in his encyclopedic survey of rocketry and spaceflight.<sup>10</sup>

The significance of Gussalli's book is that it appeared the same year as Oberth's book, which is regarded as one of the first technical books of speculative non-fiction on human spaceflight.

#### Other Publications on Rocketry and Space Travel

In 1930, Gussalli presented a report to the XIX Congress of the Italian Society for the Advancement of Science on "Astronautica e propulsori a reazione" [Space travel and rockets]. In this short report, Gussalli provides a comparison between direct propulsion rockets and his system using a double-reaction motor. He also proposes establishing an International Prize for Excellence in Astronautics. Professor Carlo Ricci of the Reale Scuola d'Ingegneria in Naples reviewed Gussalli's material but declined to offer an opinion based on the absence of details. He also reacted unfavorably to Gussalli's proposal for an international prize. This exchange led to a strained relationship between Gussalli and the society.

Gussalli published an expanded version of this report in 1941 as *Propulsori a reazione per l'astronautica – La riduzione del consumo dei propulsori può rendere possibile la navigazione negli spazi intersiderali*<sup>11</sup> [Rockets for space travel – the reduction of rocket fuel can render possible the navigation of interstellar space] to present his ideas concerning a more efficient means of space travel. In this book, Gussalli incorporates the double-reaction motor system in the design of a spacecraft designated "Vehicle for Space Travel Gussalli Mod. 1939" and presents his case for using the thermal effects of solar radiation as a power source for the auxiliary engine of the double-reaction motor to address earlier criticisms of the system design and operation. He also includes sections to

<sup>10</sup> Rynin, N.A., *Interplanetary Flight and Communication*, Vol. II, No. 4, "Rockets," pp. 74-76. Translated from Russian and published by NASA in 1971 as NASA TT F-643. Original Russian edition published in 1929.

<sup>11</sup> Brescia: Editore Giulio Vannini, 1941. In Italian.

address criticisms offered by Oberth and Esnault-Pelterie.<sup>12</sup>

#### [insert image of book cover]

In 1946, Gussalli elaborated on this proposal in *I viaggi interplanetari per mezzo delle radiazioni solari – L'abolizione del consumo dei propulsori può rendere possibile la navigazione negli spazi interplanetari*<sup>13</sup> [Interplanetary travel by means of solar radiation – the elimination of rocket fuel can render possible the navigation of interstellar space], which was published with a rough English translation to make it more accessible to international researchers. In this book, Gussalli further modifies his spacecraft design, now designated the "Gussalli 1946 System," to use the pressure effects of solar radiation acting on astral dust for interplanetary travel – this dust would be strategically placed in space through the use of rockets similar to the V-2. Gussalli also proposes the use of aerobraking to allow for spacecraft re-entry to Earth. He concludes that a spaceship using this type of propulsion would not need to be launched with the fuel necessary for interplanetary travel.

#### [insert image of spacecraft]

#### Correspondence

Much of Gussalli's correspondence from the late 1930s through the 1940s reflects his attempts to interest individuals and institutions in establishing cooperative efforts for developing his interplanetary propulsion concept.<sup>14</sup>

Gussalli wrote to Willy Ley in 1939 with such a request,<sup>15</sup> while also acknowledging the difficult world situation, especially in Europe. Ley suggested that Gussalli contact the American Rocket Society (ARS), which he did. Alfred Africano of the ARS responded with a skeptical assessment of Gussalli's proposal and declined to have the ARS participate in any joint

<sup>12</sup> He also mentions his correspondence with Esnault-Pelterie, Oberth, von Pirquet, Rynin, Goddard, and Ley.

<sup>13</sup> Brescia: Editore Giulio Vannini, 1946. In Italian, along with a rough English translation by Jeanne Wiest.

<sup>14</sup> Interestingly, there does not seem to have been any written communication with Prof. Gaetano Crocco of the University of Rome, who was involved with rocket research in Italy in the 1930s.

<sup>15</sup> Letter to Willy Ley, originally sent to Ley in Berlin (29 Aug 1939) and in a much lengthier letter to him in New York (18 Oct 1939). The latter seems to be in response to a letter from Ley dated 27 Sep 1939.

development efforts since rocket developments were of "immediate and practical importance." Gussalli made a similar request to Robert Goddard,<sup>16</sup> to which Goddard replied that, as far as he was aware, "no aviation company in the United States ... is at all interested in interplanetary tests and developments." Gussalli also sent the latest information on his projects to Hermann Oberth<sup>17</sup> and proposed a cooperative effort with German researchers. In his response, Oberth apologetically indicated his belief that there were fundamental errors in Gussalli's calculations.

Gussalli's correspondence, particularly with U.S. researchers, understandably ceased until after the end of hostilities. Following the war, Gussalli contacted a number of U.S. institutions, including the Mellon Institute of Industrial Research, the Smithsonian Institute, Los Alamos Laboratories, the American Association of Engineers, Washington University, the Institute of Aeronautical Sciences, and the Chrysler Corporation, in the hope of attracting their interest. However, his proposals were generally not well received.<sup>18 19</sup>

Much of Gussalli's other post-war correspondence reflects his efforts to refute criticism of his idea for using solar radiation as propulsion technique.<sup>20 21</sup> He prepared and distributed several (unpublished) appendices to

his book in an attempt to clarify and elaborate on his proposed scheme, but he does not appear, however, to have taken criticism well and this perhaps hampered his ability to effectively develop and market his ideas.

#### The Final Chapter

Gussalli remained a solitary figure throughout his life<sup>22</sup>, preferring to work alone.<sup>23</sup> He spent the last years of his life near Lake Garda in Barbarano di Salò (Brescia), Italy, but his health was continually undermined by a chronic illness that eventually led to his death on June 23, 1950.

In 1962, a plaque was placed on Gussalli's former home in Brescia to commemorate his contributions to spaceflight.<sup>24</sup>

#### **[insert image of plaque]**

Giovanni Caprara began to study the work of Gussalli in 1969. During his research, he contacted Wernher von Braun at the NASA Marshall Spaceflight Center in Huntsville, Alabama, to solicit von Braun's assessment of Gussalli's proposal for using solar radiation as a means of interplanetary propulsion. Von Braun responded that "this concept would not be a promising one as far as interplanetary travel is concerned."<sup>25</sup> Caprara has continued his research and works closely with the Fondazione Civiltà Bresciana in reviewing and collating the material in the Gussalli archives.<sup>26</sup>

<sup>16</sup> Letter to Robert H. Goddard, November 11, 1939 – contains a 14-page report in English, with accompanying figures.

<sup>17</sup> Von Pirquet had provided Oberth's address, apparently without Oberth's knowledge or permission. Oberth requested that Gussalli not reveal his address to anyone – he was obviously uncomfortable with public knowledge of his whereabouts.

<sup>18</sup> Letter from J.W. Crowley, Associate Director of Aeronautical Research, N.A.C.A., in response to a request from the U.S. Department of Commerce, Office of Technical Services for a technical evaluation, and recommending that no further consideration be given to Gussalli's proposal.

<sup>19</sup> Letter from Jack R. Bloom, U.S. Department of Commerce, Office of Technical Services, to Gussalli, June 18, 1947, indicating that the military authorities had no interest in his proposal. In Italian.

<sup>20</sup> "Journal of the British Interplanetary Society," Vol. 6, No. 5 (June 1947), pp. 140-141 – critical reference to Gussalli proposal in an assessment of propulsion techniques by A.V. Cleaver. Gussalli subsequently sent a letter (dated 27 Dec 1947) to Messrs. Carter and Burgess of the British Interplanetary Society in response to the Cleaver article.

<sup>21</sup> "Journal of the British Interplanetary Society," Vol. 7, No. 3 (May 1948), pp. 117-119 – summarizes a report by R.L. Shepherd critical of Gussalli's proposal. Mr. Shepherd provided the details of his analysis to Gussalli in a private communication, dated May 24, 1948.

<sup>22</sup> He never married and had no children. It is interesting to note that Ugo Gussalli Beretta, the president of the world-renowned firearms company Beretta S.P.A., is the son of Luigi Gussalli's cousin, Franco Gussalli and his wife Giuseppina Beretta. Ugo Gussalli Beretta took his mothers surname to continue the family dynasty since there were no male heirs on his mothers side of the family to carry the family name. The Beretta family has been very supportive of efforts to publicize the work of Luigi Gussalli.

<sup>23</sup> He was a landowner and apparently self-sufficient.

<sup>24</sup> *Ricordo di Luigi Gussalli – Pioniere degli studi astronautici* (Brescia, 1962). In Italian.

<sup>25</sup> Letter to Caprara dated 3 June 1969 in response to Caprara's letter of 28 Feb 1969.

<sup>26</sup> Ragni, Franco, "Un pioniere bresciano dell'astronautica – Sfidare il cosmo su un missile a vapore" in *Atlante Bresciano*, Number 48, Fall 1996, pp. 46-49. In Italian.