

He Introduced the Word Cosmonautics: The Story of Ary Sternfeld, a Forgotten Space Pioneer

By Michael Gruntman

Astronautics and Cosmonautics

U.S. astronauts and Russian (formerly Soviet) cosmonauts routinely travel in space. They orbit Earth and live and work at the International Space Station. Men landed on the Moon and plan to reach Mars. The field of science and engineering dealing with spaceflight describes itself by two different words: astronautics and cosmonautics. The United States and Western Europe commonly use the word astronautics. In contrast, the Russian language relies today almost exclusively on the word *kosmonavtika* (cosmonautics).

These two words originated from the French language—*l'astronautique* and *la cosmonautique*. Two pioneers of space exploration, Robert Esnault-Pelterie and Ary J. Sternfeld, introduced the words into the scientific language under very different circumstances.

The origin of the term astronautics is well documented.^{1, 2} In contrast, the history of the word cosmonautics remains poorly known. Ary Sternfeld, a space pioneer who introduced the latter word in 1930s, is also largely forgotten. The approaching 50th anniversary of the breakthrough to space makes it especially appropriate to remember those visionaries who paved the way to cosmos. This article concentrates on an unusual life journey of Ary Sternfeld and on cosmonautics. The stories of introduction of the words of science astronautics and cosmonautics are linked in a number of ways however and should be told together. So, we will start with a brief story of astronautics.

Astronautics Was the First

It was the Frenchman Robert Esnault-Pelterie, one of the four great space pioneers,¹ who introduced the word astronautics. Esnault-Pelterie (1881–1957), also known by his initials as “REP,” graduated in engineering at the Sorbonne University. He was the fourth man in France to obtain a

pilot's license, and he made remarkable contributions to the development of airplanes. He became an accomplished inventor, engineer, and sculptor. The French Academy of Sciences (*Académie des Sciences*) elected him a member in 1936.

In the public mind at the beginning of the 20th century, rocketry and space exploration belonged more to the realm of science fiction than to the field of serious research. Certainly, Esnault-Pelterie's fame as an aviation pioneer helped him to gain acceptance by mainstream scientific audiences. On 15 November 1912, he delivered a lecture “*Considérations sur les résultats d'un allègement indéfini des moteurs*” (“Consideration of the Results of the Unlimited Lightening of Motors”) at the meeting of the French Physical Society (*Société Française de Physique*). The abbreviated form of his presentation appeared next year in the respected archival physics journal, *Journal de Physique*.³ The lecture and the following publication became the first significant step in scientific legitimization of spaceflight.

On 8 June 1927, another prominent French learned group, the French Astronomical Society (*Société astronomique de France*), held its annual general meeting in the splendid Richelieu amphitheater at the Sorbonne. There, Esnault-Pelterie delivered a lecture “*L'Exploration par fusée de la très haute atmosphère et l'avenir des communications interplanétaires*” (“Rocket Exploration of the Very High Atmosphere and the Future of Interplanetary Travel”).⁴ The lecture “aroused lively interest” and the audience “frequently interrupted it with applause.”⁴

On 26 December 1927, Esnault-Pelterie and his friend and supporter André Hirsch organized a dinner to discuss the future of the emerging science of space travel.² Several prominent men gathered at the house of the mother of Hirsch: famous physicists Jean Baptiste Perrin (Nobel Prize in Physics, 1926) and Charles Fabry;

astronomers Felix Esclançon and Henri Chrétien; director of the hydrological service of the French Navy and president of the French Astronomical Society Eugène Fichot; General Gustave Ferrié, who had pioneered many military applications of radiotelegraphy; and science-fiction writer J. H. Rosny the elder.

The guests discussed the name that should be given to the new science. The word of science and engineering astronautics did not exist yet. Actually, science-fiction literature had used a derivative word, *astronaut*, as early as the 19th century.⁵ Esnault-Pelterie first proposed *sideration* (the word structured similarly to aviation), but it lacked appeal. Somebody suggested *cosmonautique* (cosmonautics), but it did

Astronaut in the 19th Century

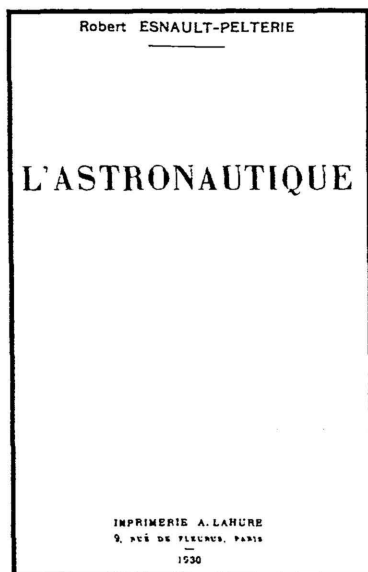
Science fiction literature used the word *astronaut* as early as in 19th century. In 1880, a spaceship *Astronaut* traveled the cosmos in Percy Greg's novel *Across the Zodiac*.⁵ It was a “vessel constructed [probably in 1830] with walls three feet thick, of which the outer six and the inner three inches were formed of the metalloid. In shape ... [the] *Astronaut* somewhat resembled the form of an antique Dutch East-Indiaman, being widest and longest in a plane equidistant from the floor and ceiling, the sides and ends sloping outwards from the floor and again inwards towards the roof. The deck and keel, however, were absolutely flat, and each one hundred feet in length and fifty in breadth, the height being about twenty feet.”

The Greg's space traveler further described his starship, “In the center of the floor and in that of the roof respectively I placed a large lens of crystal, intended to act as a window in the first instance, the lower to admit the rays of the Sun, while through the upper I should discern the star towards which I was steering.”

not appeal to them either. Then, Rosny proposed the word *astronautique* (astronautics). This was it! The scientists adopted the word at once.²

The French Astronomical Society published the expanded version (under a slightly modified title) of Esnault-Pelterie's 1927 lecture in a special supplement to a March issue of its bulletin⁶ and as a separate book.⁷ It was in these publications where the word *astronautics* appeared for the first time.

"It is rather curious to note that going from the means of locomotion [motion, transportation] on earth to avia-



Cover page of R. Esnault-Pelterie's *L'Astronautique* published in 1930. The book firmly established the new name for the emerging field of science and engineering of spaceflight.

tion and then to "astronautics," one changes [respectively] from the means of motion with velocities changing at will to the means of motion with constant velocities and finally to the means of [motion with] constant acceleration."⁷

At the same eventful dinner on 26 December 1927, the guests worked out the plan to establish an annual award in astronautics.² Esnault-Pelterie and Hirsch provided funds, 5,000 francs annually for three years, to the French Astronomical Society for the REP-Hirsch International Astronautics Prize (Prix REP-Hirsch).⁸ Esnault-Pelterie described in some detail these events:

It appeared to me desirable to create a motion of interest in favor of this future locomotion [in space] and first of all, I desired that this locomotion receives a

name. Mr. J.-H. Rosny the elder happily invented the word "Astronautics" which I immediately adopted. Next, I proposed to my friend Mr. André Hirsch, an initial instigator of this presentation [lecture at the meeting of the French Astronomical Society in 1927], to join me in establishing an annual prize [award] of the French Astronomical Society, which he accepted.

This annual international prize will receive the name the "REP-Hirsch" prize [award] and will be given for the best original technical work produced during the year and contributing to advancement of the state of one of the problems on which solution the "astronautical science" depends.

In order to coordinate the efforts, my co-donor and I asked the [French] Astronomical Society to establish within its structure a commission on "Astronautics" tasked to centralize all information related to various problems whose solutions are indispensable or specifically useful for the global solution [of the problem of space travel]: atomic science, transformation of [chemical] elements, maintenance of a breathing atmosphere in confined space, ultra-light alloys, physiological effects of acceleration, means of interplanetary navigation, etc.⁷

Two years later in 1930, Esnault-Pelterie wrote a comprehensive treatise⁹ on rocketry and spaceflight under the title "L'Astronautique." He presented the new science in a consistent and detailed way: discussed rocket motion in vacuum and air, considered gas flows in converging-diverging nozzles, applied thermodynamics to the combustion processes of various fuel-oxidizer combinations, and pointed out the exceptional properties of atomic hydrogen as propellant. Esnault-Pelterie outlined possible rocket applications including studies of the aurora borealis and of the upper atmosphere and missions to the Moon and to the planets. He suggested reaction wheels for spacecraft attitude control and discussed the effects of space flight on humans.

The name of the new field in science and engineering—Astronautics—had thus been firmly established and quickly accepted. The French scientists did not consider this word as a word of science fiction literature: they coined it for the emerging science field. The word *astronautics* became known to the world exactly in the intended meaning, the art or science of designing, building, and operating space vehicles, and it entered many languages.

The French Astronomical Society formed a committee of prominent scientists to award the REP-Hirsch awards. A stellar reputation of the committee members helped to establish the respectability of the emerging science and to transform it into a serious technological undertaking. A leading learned society anointed astronautics. Bringing rocketry and spaceflight into the scientific and engineering mainstream proved indispensable to realization of the space age. Amateur societies, rocket enthusiasts, and popular magazines would have never brought people to where they are in the 21st century.

The first REP-Hirsch Award went in 1929 to Hermann Oberth for his book *Wege zum Raumschiffahrt* (*Road to Space Travel*).¹⁰ The awards were given until 1939 and played an important role in stimulating development of rocketry. They also helped in building links among rocketeers of various countries, soon to be reduced to smoking ruins by a world war. The REP-Hirsch encouragement award also recognized—in 1934—Ary J. Sternfeld,¹ who introduced the word *cosmonautics*.

Dreams about Space and Communism

The story of the word *cosmonautics* is a story about a largely forgotten space pioneer. Step back in time to France in the late 1920s and meet a young Polish Jew Ary J. Sternfeld (1905–1980).

Ary was born in a Polish town, Sieradz. He got interested in space travel as a teenager. After graduating from a gymnasium (high school) in the industrial Polish city of Lodz, he enrolled in the Jagiellonian University in Krakow in 1923. One year later, he went to France to study mechanical engineering at the University of Nancy. He graduated in 1927.¹¹



Ary J. Sternfeld in France in 1932.

Photo courtesy Polytechnic Museum, Moscow

A successful career of a mechanical designer and engineer did not satisfy Sternfeld. He remained fascinated with the ideas of space travel. Consequently, Sternfeld enrolled in a graduate program at the Sorbonne in Paris, staying there for three years from 1928 to 1930. Unfortunately for Ary, his science advisors declined his proposal to write a dissertation about interplanetary flight. Sternfeld disagreed and left the Sorbonne. He wanted to work on spaceflight. As Sternfeld explained it later,

A dream of building a spaceship brought me [first] to the Jagiellonian University (Krakow), then to the Institute of Mechanics of the University of Nancy, and then to the Sorbonne [University]. Draft pages of the future book "Introduction to Cosmonautics" [published later in 1937] multiplied. But these pages had not, as I thought about it, become my [doctoral] dissertation on future space flights. My official [sci-



Ary J. Sternfeld with his wife Gustava in Paris in 1934.
Photo courtesy Polytechnic Museum, Moscow.

ence] advisors . . . refused to approve such a fantastic topic [of spaceflight] for the dissertation. They suggested concentrating instead on theory of metal cutting (since I had designed by that time a couple specialized mechanisms for machining wood), offering an increased stipend and unlimited time for completing the dissertation. But I declined these offers and decided to devote my effort to cosmonautics and to continue my work in this direction relying on myself.¹²

Sternfeld published his first two articles about space travel on 19 August and 2 September 1930.¹³ Esnault-Pelterie had introduced the word astronautics two years earlier in 1928. The word had been widely accepted and Sternfeld used it four times.

Sternfeld's first articles appeared in *L'Humanité*, the official newspaper of the

French Communist Party. As early as high school, Sternfeld became involved in the socialist movement. His older sisters, especially a member of the Polish Communist Party Franka, influenced young Ary. Ary's future wife was also an active member of the Polish section of the French Communist Party.¹¹

Sternfeld met in France and married Gustava Erlich, a schoolmate of his sisters in Lodz. Gustava studied psychology and taught French language to foreigners at the Sorbonne. Her knowledge of French would become handy later when her private French lessons helped the family survive hardships in the Soviet Union.

Sternfeld's articles in *L'Humanité* appeared under a French sounding name of "engineer L. Rolin," concealing the identity of the author. It is possible that Ary coined the penname by transposing the letters in the name of a famous Frenchman René Lorin. Lorin studied applications of jet propulsion in aviation since 1907 and invented the ram-jet in 1913. Sternfeld was well aware of René Lorin and his work.¹⁴

Sternfeld's publications in *L'Humanité* described the rocket as the means of space travel. He wrote about major contributions to the concept of rocketry and spaceflight by Robert Esnault-Pelterie, Robert H. Goddard, Hermann Oberth, and Walter Hohmann. He especially credited the Russian Konstantin E. Tsiolkovsky for developing the "scientific foundation" of the new field. (Sternfeld first exchanged letters with Tsiolkovsky in June 1930.¹⁵) Sternfeld included a photograph of Tsiolkovsky and suggested that a "justified title" for him was "a father of the astronautical science."

Publicizing achievements of Russian space pioneers directly contributed to propaganda by communists and their fellow travelers, who projected an appealing humane image of the Soviet Union. Sternfeld concluded his second article in *L'Humanité* as follows:

Although the theoretical studies of the problem of interplanetary navigation are already sufficiently advanced, the practical solution of the problem still requires much research and many experiments, which would carry enormous expenditures.

Lack of immediate profit makes a capitalist [commercial] company completely uninterested in this major problem [of interplanetary navigation]. It is known in fact that it is the socialist society of tomorrow that will be the heir of

Desire to emigrate to the Soviet Union

Already in 1929 I petitioned the office of the Soviet Trade Representative in Paris about my desire to relocate to the Soviet Union. However, my petition went unanswered. In July-August 1932 I traveled to Moscow to present the design of my robot. In 1934, I resumed my petition to relocate to the USSR. Since July 1935 . . . I have been living in Moscow and I am a Soviet citizen since September 1936.

From autobiography submitted by A.J. Sternfeld with his letter to Chairman of the Presidium of the Supreme Soviet of the USSR M.I. Kalinin in May 1944.¹⁷

the scientific and industrial progress. It will be the socialist society that will master space.¹³

By the early 1930s, the socialist society of the Soviet Union had exterminated millions of people in an unmatched feat of social engineering. Many more would perish—with a cheerful support of Western leftists—in the following years. Not only political opponents, but also millions of other men, women, and children belonging to unwanted groups were murdered, tortured, banished, and confined to concentration camps where many died from maltreatment, starvation, overwork, and savage conditions.¹⁵ As the U.S. Senate described it factually, "Communism has claimed the lives of more than 100,000,000 people in less than 100 years."¹⁶ Sternfeld became one of many Westerners who changed his life to support this social experiment. He himself would be cruelly punished by socialism.

Sternfeld's ideological and emotional links to the beloved socialist paradise further solidified in 1932, when he visited Moscow for one month.^{11,12} The French Communist Party recommended his design of a robot to the Soviet Ministry of Heavy Industry. For one month Sternfeld lived and worked in a luxurious hotel in downtown Moscow. He later explained,

I felt such a captivating atmosphere of building the new [Communist] world during this my trip to the USSR. Despite food rationing in the Soviet Union in those years, despite poorly dressed people in the streets, and [despite that] Moscow with its long lines [in stores] produced unhappy impression compared to fake glamour of Western capitals, all that could not dissuade me from the decision to move [relocate] to the USSR in order to live and work there.¹²

REP-Hirsch Encouragement Award

From Moscow, Sternfeld returned to the home of his parents in Lodz, Poland. It was August 1932. Ary stayed there for one year and a half in seclusion working on a manuscript, collecting his ideas about spaceflight. He wrote in French, with his sister typing for him and his wife editing the manuscript.

Ary recalled very difficult conditions,

There was not even enough paper: I was writing on pieces of wrapping paper . . . which I first cut to the same size. Besides, there was very little light in the room, with direct sunlight never reaching it. Breathing was difficult because it was impossible to open the window—there was a communal latrine next to it [the window] in the yard, without a sewage line. Under such conditions I worked days and nights, bringing myself to exhaustion.¹⁸

The 490-page manuscript titled “Initiation à la Cosmonautique” (“Introduction to Cosmonautics”) was finally ready in November 1933. Sternfeld thus firmly chose the new word *cosmonautique* (cosmonautics) instead of the already accepted *astronautique* (astronautics). A local Lodz artist, Ch. Hiller, designed a cover for the manuscript. It showed a trajectory for efficient transfer to an orbit approaching the central body suggested by Sternfeld and three characteristic spacecraft velocities (velocity in a circular Earth orbit, escape velocity from the Earth, and escape velocity from the solar system). These velocities would become known later in the Soviet technical literature as the first, second, and third cosmic velocities, respectively. This manuscript cover was first published, as a frontispiece, in a later Russian translation of the manuscript.¹⁹

With little hope of publishing the manuscript in his native Poland, Sternfeld went to Paris in December 1933. Following the advice of well-known French physicist Paul Langevin, he promptly submitted his manuscript for the REP-Hirsch Award. Sternfeld also made two presentations of his results at the meetings of the prestigious French Academy of Sciences (Paris), with the written versions appearing in Academy’s *Comptes rendus*, or *Reports*. Making presentations required endorsement by the members of the Academy of Sciences, which was done by Jean Perrin and Ernest Esclangon.

At the 22 January 1934 meeting of the Academy of Sciences, Sternfeld out-

lined a technique for determining positions and velocities of interplanetary spacecrafts.²⁰ The concept was based on determining the distance to the Sun by measuring the equilibrium temperature of a body. A gyroscopic system with the axes fixed in inertial space established the direction toward the Sun.

Then on 19 February 1934, Sternfeld described orbital transfer from a given Keplerian orbit to a trajectory approaching a point near the central body.²¹ He showed that bi-elliptical transfer might minimize required velocity increments if a space vehicle first moved away from the central body and raised the transfer orbit apocenter. This counterintuitive finding has become perhaps the best known contribution of Sternfeld to orbital mechanics, his trademark. The cover of his manuscript highlighted this trajectory. After his death, it would be engraved on his tombstone. It seems appropriate to call such an orbital maneuver “Sternfeld transfer.”

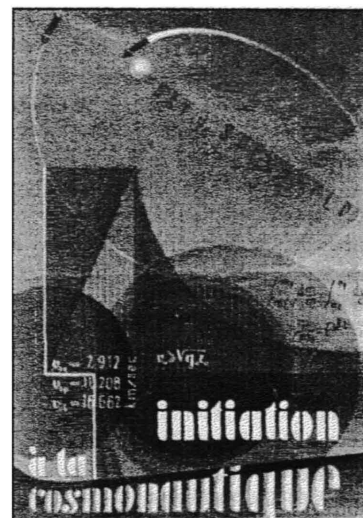
Ary Sternfeld also discussed his spaceflight ideas at a meeting of the French Astronomical Society on 2 May 1934. The session chair warmly thanked him for the interesting talk, “you are as much a poet as an implementer. You have faith in the ideal of future times and I wish you to preserve this creative spirit for a long time.”²² The audience responded with animated applause.

On 6 June 1934, the Committee on Astronautics of the French Astronomical Society bestowed the REP-Hirsch Award of Encouragement (Prix d’Encouragement) on Ary Sternfeld. The minutes of the Society described the award:

From A.J. Sternfeld to A.Ya. Shternfel’d to A.A. Shternfel’d

Ary Jacob Sternfeld was born to a Jewish family in a town of Sieradz in Poland. Germanic names were common among Jews settled in Poland. Many of them arrived to that land from Germany, in wandering – several centuries long – through sometimes welcoming and sometimes murderously hostile parts of Europe. When Ary went to France for study, his name was spelled *Sternfeld* as it would be in German. The first two letters “St” in his name are pronounced in German as two English sounds “sh” and “t.” Later, Polish publications would often spell his name as *Szternfeld*, with the Polish sibilant sound “sz” rendering the sound “sh” of English. When Sternfeld emigrated to the Soviet Union, his name was now written in Cyrillic as Штернфельд, with the sound “l” softened to “i” (“ль”). When his name was transliterated back into English, it was correspondingly converted into *Shternfel’d*, with “Sh” rendering the Russian letter “Ш” and the apostrophe rendering the soft sound “i” in “fel’d.”

In an interesting twist, Sternfeld’s middle initial also changed. His original initials A.J. stood for his first and second names, *Ary Jacob*. This was how his name appeared in the first French publications. The Russian convention does not recognize second names. Instead, patronymics are used. The patronymic is an adjective in the possessive case formed from a paternal name. In Russian, Sternfeld’s initials eventually became A.A., standing for *Arii Abramovich*, with the patronymic *Abramovich* formed from the name of Sternfeld’s father, Abram. Interestingly, at first in Russia Sternfeld’s second initial, Ya. (rendering the Russian letter Я), derived from his second name Jacob.¹⁹ So, the original name A.J. *Sternfeld* was rendered in translations of his Russian books into English in 1950s and 1960s either as A.A. *Shternfel’d* or A.A. *Shternfeld*.



Cover of the manuscript “Initiation à la Cosmonautique” first published as frontispiece in a Russian translation of the manuscript in 1937.¹⁹ The cover shows Sternfeld transfer to a point near the central body, three “cosmic velocities,” and equations relating rocket velocity and mass. The name of the artist who designed the cover shows in the right upper corner.

Photo courtesy Maya A. Shternfel’d and Polytechnic Museum, Moscow

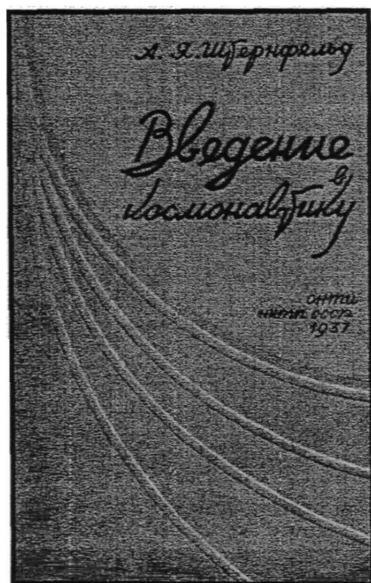
To Mr. Ary J. Sternfeld, the Award of Encouragement, for his interesting treatise titled “Initiation à la Cosmonautique,” expressing regret that [the Committee] could not better recognize the definitely considerable effort of Mr. Sternfeld, because this effort had unfortunately been applied to a large number of questions which does not fit into the first article of the Rules of the Award.

The Committee on Astronautics would like to state that the questions of pure

theory [of spaceflight] seem now to be well clarified, and it will attribute henceforth more importance to experimental results or to the work capable of accelerating obtaining such results.

It is necessary, in fact, to note that one knows sufficiently about general conditions of astronautical travel and it is of little interest to perfect their details, while we are not able to send a rocket to a 100-km altitude (even much less than that) in order to explore directly the real composition of the upper atmosphere.²³

The first article of the Rules had specifically required the work to advance "one of the problems on which solution depends the realization of interstellar navigation or advancing the knowledge in one of



Cover of Sternfeld's 1937 book *Vvedenie v Kosmonavtiku* (*Introduction to Cosmonautics*).¹⁹
Photo courtesy Maya A. Shternfel'd and Polytechnic Museum, Moscow

the branches relevant to the astronautical science."⁹

Clearly, Sternfeld's broad treatise "Initiation à la Cosmonautique" did not fit into the defined category. The Award of Encouragement was however a major recognition of the contribution of the young engineer. Sternfeld followed the award by publishing a number of articles in popular and trade publications in France.^{14, 24} His articles unambiguously introduced the new scientific word *cosmonautique* in the titles.²⁴

"Introduction to Cosmonautics"

After accepting the REP-Hirsch Encouragement Award, Sternfeld began to receive "very serious and attractive offers of continuing [his] scientific work in the West."¹⁸ He wrote that he,

replied then to all of them "no" and "no." It was so that I had firmly decided to relocate to the Soviet Union forever, in order to facilitate development of cosmonautics with all [my] abilities in the then-only socialist country. Already then I deeply believed that the Soviet Union would be the country to open the road to cosmos to the humankind.¹⁸

On 14 June 1935, Ary Sternfeld and his wife arrived in the Soviet Union to settle permanently. One month later, Sternfeld joined Moscow's Jet Propulsion Scientific Research Institute, the famous RNII. Marshal Mikhail Tukhachevsky formed RNII in September 1933 to consolidate the Soviet effort in jet propulsion.¹ The institute embarked on large-scale research-and-development programs in solid- and liquid-propellant missiles and rockets. Many leading Soviet pioneers of rocketry and spaceflight worked at RNII in the 1930s, including Fridrikh A. Tsander, Valentin P. Glushko, Sergei P. Korolev, and Mikhail K. Tikhonravov.¹ The transformation of Ary Jacob Sternfeld (A. J. Sternfeld) into Arii Abramovich Shternfel'd (A. A. Shternfel'd) had begun. He became a Soviet citizen on 4 September 1936.¹¹

In RNII, Sternfeld concentrated on various problems of rocket dynamics. He also prepared his manuscript "Initiation à la Cosmonautique" for publication with the help of deputy director of RNII Georgii E. Langemak, who translated it into Russian.

In 1937, the leading Soviet publishing house of technical literature printed 2,000 copies of the book *Vvedenie v Kosmonavtiku* (*Introduction to Cosmonautics*) by A. Sternfeld.¹⁹ The book was largely based on Sternfeld's original manuscript for which he had received the REP-Hirsch Award. A few omissions included hypothetical inhabitants of other planets described by earlier writers and the idea of mirrors in space illuminating Earth.²⁵ The book's cover page explained that it was translation "from a manuscript in French" and that the original manuscript had been "augmented by new research results in 1935–1936."

Sternfeld's *Introduction to Cosmonautics* was a major treatise on the fundamentals of the new science called, in

the title, cosmonautics. He described conditions in space, rocket dynamics, processes in combustion chambers and nozzles, applications of rockets, physiological effects of spaceflight, and orbital mechanics, including flights to the Moon and planets. The book preface (dated "Paris, December 1933") opened as follows, "During several centuries a number of scientists, whose names the reader would see many times in this book, contributed to the science that we now call cosmonautics."²⁵

Why did Sternfeld insist on using the new word, cosmonautics, instead of the already established and widely accepted astronautics? In the book's second edition²⁵ in 1974, he added the following explanation footnote to the preface to the book's first edition:

The author believes that the word "cosmonautics" (*cosmonautique*) used in the English and German languages and introduced by him to the French terminology is more correct than "astronautics" (*astronautique*) because the definition of a science studying motion in interplanetary space should provide the notion of the medium where the motion is assumed to occur (*cosmos*) but not one of its goals [goals of the motion].²⁵

Cosmonautics Comes Out on Top

The introduction of the new word *kosmonavtika* (*cosmonautics*) was not first welcome in the Soviet Union. A prominent Soviet space writer, Yakov I. Perel'man, wrote in his review of the Sternfeld's *Introduction to Cosmonautics*,

The translator of the book uses the word "kosmonavtika" [*cosmonautics*]. While this word may be preferred in French compared to "astronavtika" [*astronautics*], it is hardly justified to introduce the word to the Russian language with the existing [Russian] word "zvezdoplovanie" [*star sailing*] already established to a certain degree. "Zvezdoplovanie" is more in the spirit of the Russian language than "kosmonavtika."²⁶

The compound word *zvezdoplovanie* is similar to, a linguistic calque of, the word *astronautics*: *zvezda* means a star, and *plavanie* means navigating or sailing. The word *zvezdoplovanie* was structured similar to another word common in the Russian language of the early 20th century—*vozdukhoplovanie* (*vozdukh* means air)—until this word was later largely replaced by a word of similar meaning, *aeronavtika* (*aeronautics*).



Ary Sternfeld in Moscow, January 1941

Photo courtesy Polytechnic Museum, Moscow

Moreover, Tsiolkovsky himself anointed the word *zvezdoplavanie* and the related word *zvezdolet*, or a starship. (Tsiolkovsky however also used the word *astronautics*, for example, in private correspondence to Fridrikh Tsander in 1932.²⁷) Perel'man wrote in 1932, "*Zvezdoplavanie*"—controlled motion of a vehicle ("*zvezdolet*") in space. Both words ["*zvezdoplavanie*" and "*zvezdolet*"] are suggested by me and approved by Tsiolkovsky, who uses them in his latest publications."²⁸

A major authority in the pre-World War II Soviet space literature, Perel'man (1882–1942), was known for his numerous popular books about mathematics, physics, mechanics, rockets, and interplanetary travel. He personally had known Tsiolkovsky since as early as 1913.²⁸ Perel'man published his famous popular book, *Mezhplanetnye Puteshestviya* (*Interplanetary Travel*), in 1915. In 1935, the book went through the tenth edition of 50,000 copies.²⁹ It was Perel'man who, through his popular publications, made Tsiolkovsky's ideas and writings known to broad segments of the public in Russia.¹⁻²⁹⁻³¹

In spite of Perel'man's disapproval, the word *cosmonautics* would eventually become accepted. It had first to compete however with the word *astronautics* that dominated Soviet technical and popular writings for many years. (Many authors also continued to use the word *zvezdoplavanie*.³¹) For example, when Moscow spaceflight enthusiasts formed a group in the V. P. Chkalov Central Aero Club in January 1954, they called it a Section of *Astronautics*. Sternfeld himself published an article, titled "*Astronautics*," about spaceflight in an official magazine for high school physics teachers.³² He described in

this article the "first astronomical velocity," "second astronomical velocity," etc. These characteristic velocities would later be called "cosmic velocities" in the Russian technical literature. Sternfeld's highly popular book on artificial satellites,³³ published in 1956 and then in an expanded edition³⁴ after the *Sputnik* launch in 1958, also used the word *astronautics*. The official organ of the Communist Party of the Soviet Union *Pravda*, the ultimate authority on all forms of political correctness in the USSR, described the new science as *astronautics* in an article celebrating the successful hit of the Moon by a Soviet space probe in 1959.³⁵

Finally, the word *cosmonautics* achieved supremacy. The flight of the first human—a cosmonaut—to space in April 1961 effectively ended any competition between the two words. The field of science and engineering would be uniformly called *kosmonavtika* (*cosmonautics*), with *kosmonavty* (*cosmonauts*) traveling in space. On 12 April 1962, the Soviet Union marked the first anniversary of Yuri Gagarin's

spaceflight by celebrating the first *Cosmonautics Day*.

Socialism Bites Back

Ary J. Sternfeld introduced the new word *cosmonautics* in a pioneering effort of the early 1930s. The word is now an official name for a field of science and engineering in his country, his country by his own choice. One would think that this bright young man, a space visionary and a true believer in socialism, successfully put all his abilities to advancing spaceflight in the Soviet Union and materially contributed to the breakthrough of *Sputnik* and beyond. It has not happened that way, however. Sternfeld was very much lucky to stay alive.

After settling in Moscow, Sternfeld quickly lost his job in RNII. The Soviet state would never allow him to join any work on spaceflight and rocketry. The authorities would also never permit him to leave or travel outside the Soviet Union even in order to receive honorary degrees and awards. The only exceptions would be short filled-with-propaganda trips to communist-

Translator of Initiation à la Cosmonautique on the Stalin's list

Deputy Director of the Jet Propulsion Research Institute RNII Georgii E. Langemak translated Sternfeld's manuscript from French. Langemak, together with RNII Director Ivan T. Kleimenov, were arrested in early November 1937. They were executed (shot) on January 11 and 10, respectively, 1938. In 1991, they were posthumously given the highest Soviet non-military state decorations (Hero of Socialist Labor with the Order of Lenin) in recognition of their contributions to development of rocket weapons.¹

The recently (late 1990s) publicized materials from the archives of the President of the USSR (Russia) shed some additional light on purges in RNII, the institute where Sternfeld worked for two years. These details also illustrate how lucky the true Communist believer Sternfeld happened to be, in spite of the deprivations, not to perish in those years in the country of his political choice. The revealed archival documents include the *spiski* (or, in English, lists) of individuals which were reviewed by the selected members of the Politburo of the Communist Party of the Soviet Union. The infallible leaders of the enthusiastic leftist state then "recommended" the sentences for the court trials or other expedited judicial procedures to follow for those on the lists. Almost 45 thousand individuals were in the uncovered lists, mostly dated from 1936–1938. The Category I treatment, which meant execution, was approved for most of them. These lists are now called Stalin's *spiski* (Stalin's lists) thus obfuscating the fully deserved credit to the socialist ideology and to the Soviet society as a whole. Although describing the fate of a tiny fraction of millions of human beings annihilated in the Soviet Union, these lists bring personal stories to an otherwise largely impersonal abomination, continually (and conveniently for many) fading away from memories.

On one day, 3 January 1938, four members of the Politburo of the Communist Party, Andrei A. Zhdanov, Vaycheslav M. Molotov, Lazar M. Kaganovich, and Kliment E. Voroshilov, reviewed the lists of total 2781 people of whom they unanimously – as it invariably happened in Marxist states – approved the "recommendations" of Category I, or death, to 2558 individuals. Among those were RNII's Kleimenov and Langemak, the translator of Sternfeld's manuscript. (On a personal note, the uncle of the author of this publication was also on the lists considered on that same day and he was also condemned to Category I and murdered.) Interestingly, the future leading Soviet rocketeer Sergei P. Korolev was also "recommended" to Category I on 25 September 1938, with the list signed by Iosif (Joseph) V. Stalin, Molotov, Kaganovich, and Voroshilov. Korolev happened to be in a small group of truly lucky people who somehow – by a quirk of a bureaucratic system – were not quickly executed and eventually survived.

controlled Poland in 1964, 1967, and 1976. Poland and other fraternal socialist countries were considered relatively safe because Soviet citizens could not defect from there to the free world.

When Sternfeld published his comprehensive treatise on cosmonautics in 1937, he optimistically looked to the future. He lived and worked in his chosen country that, in his own words, was "the first to experience a socialist revolution, thus creating unlimited opportunities for social progress."¹² This was also the year when a wave of political purges had reached impeccably loyal parts of the Soviet establishment. The heads of leading Soviet rocketeers began to roll in the late 1937 and in 1938, after the patron saint and protector of the Soviet rocketry Marshal Mikhail Tukhachevsky was arrested and shot during a purge of the communist inner ruling circle.¹ RNII director Ivan T. Kleimenov and deputy director Georgii E. Langemak (the translator of Sternfeld's manuscript) were shot in January 1938. RNII's Valentin P. Glushko and Sergei P. Korolev were arrested in 1938 and imprisoned for several years.¹

Sternfeld took a temporary leave of absence from RNII in August 1937 in order to work in another institute on the design of a robot. At the end of 1937, he first lost his job in RNII and then, in April 1938, the job in the other institute. He would never find a research-and-development job, or any technical job, in rocketry or spaceflight. "While the scientist [Sternfeld] did not share the tragic fate of his other colleagues in the institute [RNII] . . . he took . . . [his removal from the rocket work] as a life catastrophe."³⁶ The socialist society could not trust a former foreigner and a true believer in communism. Never mind that Sternfeld personally sacrificed so much to advance the cause of socialism. Being a Jew would soon make Sternfeld's situation even worse as the

Soviet state-sponsored anti-Semitism rapidly gathered strength.^{37, 38}

Sternfeld knocked at many doors in attempt to interest the Academy of Sciences and industrial institutions in his work in astronautics. All the doors remained closed to him. Sternfeld was not the first or the last Westerner who joined the march to a socialist paradise and who was subsequently cruelly punished by the Soviet state.

Desperate, Ary Sternfeld sent a letter to the Father of the Peoples, Joseph Stalin, himself. He summoned all conceivable arguments, including those of a good Marxist:

Since 1929 I had tried to emigrate [sic] to the Soviet Union desiring to work for the benefits of the working class . . .

I dare to ask you to help me to get a possibility to continue my works.

Already for more than 10 years I have been working on the problems of interplanetary communications [travel]. My treatise on jet [propulsion] motion and space travel (Introduction to Cosmonautics, 1937) . . . received an international award in astronautics (1934, Paris). I hope that my future work in this field will be fruitful.

It is necessary to say that since the death of Konstantin Eduardovich Tsiolkovsky nobody—as far as I know—works on these problems here in the USSR.

There are pitiful practitioners who claim that we know sufficiently about theoretical capabilities of interplanetary travel and that we need to work exclusively on tests in the field of rocket technology.

Such statements are deeply wrong. It seems to me that these comrades completely do not understand the guidance of the classics of Marxism about the role of theory that should shine the light on the road for practice.

. . . There is no doubt that development of such . . . theoretical problems as interplanetary communications [travel] also accelerates solution of practical

problems such as, for example, ultra-high-speed travel on the ground, extra-long-range artillery, etc.

While hundreds of our people work on experimental problems of jet [propulsion] motion, nobody works on the future [problem of] motion in vacuum in the special institute [author note: Sternfeld likely meant RNII] and in other [research] groups.

On the other hand, enormous state resources [funds] are continuously directed to works on certain problems in astronomy, entirely detached from practice . . . As far as cosmonautics is concerned, which is essentially an "applied" astronomy, nobody works on these problems at all.

It seems to me paradoxical that at the time when the problems of interplanetary communications [travel] are so important for the Soviet public, as witnessed by large demand for articles and other [published] materials in this area, there is no possibility for normal scientific research work for one, who I am, of the few specialists [in this area] in the world.

I want to give all my knowledge and abilities to my new, true Motherland.¹⁷

Sternfeld's words pointing that some "pitiful practitioners" and "comrades completely do not understand the guidance of the classics of Marxism" or that "enormous state resources" are being wasted on problems "entirely detached from practice" might have easily triggered persecution of other scientists and specialists, with their heads literally rolling. With his life wrecked by the socialist state and being trapped, Sternfeld perhaps inadvertently denounced others. It is unknown whether this letter had any consequences. In any event, no response or help came from Comrade Stalin.

Although Ary Sternfeld belonged to an exceptionally "high-risk" category of Soviet citizens as a former foreigner he was never arrested, tortured, imprisoned, banished, or murdered. He was definitely lucky to live through that time and survive. Sternfeld's daughter, Maya, speculates that her father's luck is explained by the fact that he did not work in any organization and thus "did not exist" for the authorities [Maya A. Shternfel'd, conversation with the author, 19 May 2006]. Without a job, Sternfeld continued his studies of spaceflight on his own.



Sternfeld's books *Iskusstvennyye Sputniki* (Artificial Satellites)³³ 1956 (75,000 copies) and *Ot Iskusstvennykh Sputnikov k Mezplanetnym Poletam* (From Artificial Satellites to Interplanetary Travel),⁴⁶ 1957 (100,000 copies).

As his daughter wrote later,

from that time [1937] on and till the end of his life during the 43 years he remained a lone-scientist who spent sometimes 20 hours per day at his desk at home studying theoretical problems of spaceflight, stubbornly following his path. That he did not belong to any organization and even did not belong to a trade union [as practically everybody did in the USSR] saved him from Stalin's [concentration] camps. He was not even permitted to join the armed forces [during the war].³⁹

So, Ary Sternfeld concentrated on popular writings about spaceflight. His articles on astronautics and about history of Russian rocketry appeared in newspapers and popular magazines. Only once, in 1945, he published an article in a scientific archival journal, *Doklady or Reports of the Academy of Sciences*. The Sternfeld family went through hard times, with some financial help after World War II from Ary's sister in Poland. She was the only member of the close family who survived the war. The remaining relatives perished in the final solution prepared for the Jews by national-socialist Germany.

Rootless Cosmopolitans

We do not know why exactly Sternfeld was not persecuted in late 1930s and survived. It looked like a miracle for someone with his background. Another such miracle occurred in 1951, when he could have perished in an anti-Semitic campaign launched by the all-powerful leftist state against "rootless cosmopolitans."^{37, 38}

Beginning in the late 1940s, many leading Soviet managers, scientists, engineers, writers, administrators, doctors, and other professionals were losing their jobs because they were Jews. The campaign switched into high gear on 28 January 1949 with an editorial in the Communist Party's *Pravda*. The article unmistakably singled out Jews under the euphemism "rootless cosmopolitans" and called to decisively wipe out these "worthless individuals, lacking healthy feeling of love to the Motherland and to the [Soviet] people, having nothing except ill-will."⁴⁰

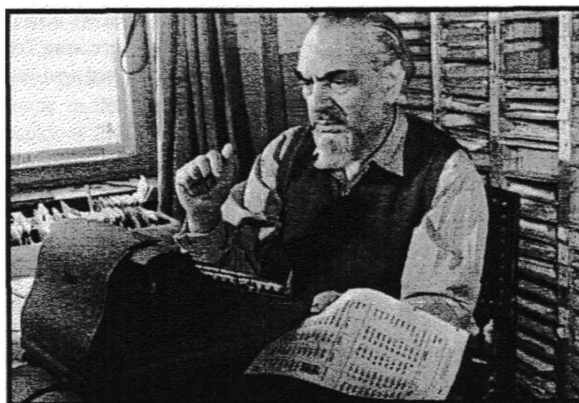
This broad persecution of the Jews culminated in 1953 with an infamous cooked-up doctors' plot by a "terrorist . . . gang of human-looking animals" and "enemies of the people" to "shorten lives of active leaders of the Soviet Union."⁴¹ The editorial in *Pravda* explained that the accused Jewish doctors were "bought by the

American intelligence" and were agents of "Jewish bourgeois nationalists" and that the arrest of this criminal group "unmasked a true face of slave-owners-cannibals from the USA and England." Only Stalin's death in March 1953 stopped the forthcoming bloodbath of a modern pogrom. Subsequently, the persecution of Soviet Jews would gradually abate into less violent forms, characterizing the last 40 years of the Soviet Union.

The emerging Soviet ballistic missile and space establishment was not immune to persecution of the Jews. For example, the first director of Scientific Research Institute N. 88 (NII-88, later known as TsNIIMash and home of the Manned Spaceflight Control Center) Lev R. Gonor was fired in July 1950 and arrested in January 1953.^{37, 38} (A government decree established NII-88 in Podlipki near Moscow in 1946 as the leading research institution in liquid-propellant ballistic and antiaircraft missiles.¹ Many top Soviet rocket designers, including Sergei P. Korolev and Mikhail K. Yangel', worked in NII-88. The institute also housed German V-2 rocketeers brought to the Soviet Union in 1946.)

At this perilous time a fellow rocketeer denounced a seemingly harmless writer of popular articles, Ary Sternfeld. Nikolai G. Chernyshev published a short note⁴² in the newspaper *Kul'tura i Zhizn'* (*Culture and Life*), the official organ of the Department of Propaganda and Agitation of the powerful Central Committee of the Communist Party. Chernyshev stated that Sternfeld misled the public that he had been awarded an international "encouragement prize in astronautics." He then continued,

There has never been an international encouragement prize in astronautics and it does not exist. In reality, the history of this question is the following. A foreign engineer R. Esnault-Pelterie, known for his unsuccessful infringement on the priority of [the work of] Tsiolkovsky and for self-glorification, established in 1927 in France, as charity, jointly with a capitalist A. Hirsch, an encouragement prize for "the best works in astronautics." This award has been correspondingly called the "award of R. Esnault-Pelterie-Hirsch" and not an international encouragement prize. This award was given not by an international



Ary Sternfeld in his home office in Moscow, 12 December 1959.

Photo courtesy Polytechnic Museum, Moscow

committee, but by the French astronomical society.

This was the prize that was given to A. Shternfel'd in 1934 for his treatise "Introduction to Cosmonautics," filled with admiration of foreign authorities [of spaceflight] and with disdain to achievements of the Russian and Soviet science. In this treatise, contrary to the facts, Shternfel'd claimed the priority of French authors in the field of theoretical foundations of interplanetary communications [travel], in every possible way extolled imaginary "scientific achievements" of R. Esnault-Pelterie and suppressed [and ignored] research of Kibalchich, Tsiolkovsky, and other Russian scientists, whose bold creative thought went substantially ahead of foreign researchers.⁴²

The veteran rocketeer Doctor of Science Chernyshev (1906–1953) was a prominent specialist in chemistry of rocket propellants. In the 1930s, he worked in the Gas Dynamical Laboratory (GDL) in Leningrad and then in RNII. In the late 1940s, he joined the leading military research institute in ballistic missiles [NII-4]¹ in Bolshevo near Moscow. Chernyshev also published popular books on spaceflight,³¹ which made him especially qualified to destroy Sternfeld. (Chernyshev also loyally contributed to a major Soviet effort—in full swing since 1946—to claim priority in science and technology for Russian/Soviet scientists, engineers, and inventors. He wrote, for example, that "our [Russian] ancestors used military rockets in the first half of the 10th century."³¹)

In the middle of the state-guided anti-Semitic campaign, a denunciation by a prominent member of the establishment could have sent the Jewish and suspicious former foreigner Sternfeld straight to a con-

centration camp. He was expendable and nobody would have come to his defense. Sternfeld was not indispensable to be spared as were some leading Soviet nuclear physicists or aircraft designers such as Sergei A. Lavochkin (of the World War II La family fighter-plane fame) and Mikhail I. Gurevich (of the later Mikoyan-Gurevich MiG fame).

The milder consequences of the article quickly followed:

The publication by Chernyshev was a crashing blow to the reputation of Shternfel'd. His articles could not be published, the publications already in printing houses were destroyed, including an article . . . on the nature of the Tungus meteorite [Tunguska event of 1908]. Shternfel'd began a stubborn fight against the accusation and wrote letters to the newspapers and to Secretary of TsK VKP(b) [Central Committee of the All-Russian Communist Party (Bolsheviks)] M. A. Suslov . . . Shternfel'd reminded about his [personal] friendly relations with K. E. Tsiolkovsky and that it was he who was the first in 1930 to tell about Tsiolkovsky's works to the French public. A. A. Shternfel'd especially emphasized that he was the first among Soviet authors who published an article about the history of Russian rockets in the 17–18th centuries, and that during many years he specifically argued about the advanced [leading] role of Russian scientists and inventors in the development of artillery.⁴³

It was truly ironic that Sternfeld who had done so much for popularizing Tsiolkovsky and his achievements in the

West was now viciously attacked for suppressing Tsiolkovsky's works. Ary Sternfeld had again miraculously survived the calamity.

In the Spotlight

In a twist of fate, a spotlight of international attention focused on Ary Sternfeld in the late 1950s. In 1955, Sternfeld published a 56-page book, *Interplanetary Travel*, with the second edition in 1956.⁴⁴ In 1956, he wrote another book, *Artificial Satellites of the Earth*.³³

The Soviet Union launched the first artificial satellite, *Sputnik*, on 4 October 1957. This feat of science and technology was also a potent weapon in a sharp ideological confrontation of the cold war.¹ The Soviet launch did not come as a surprise to people in the know in the United States. A number of open publications in the USSR and pronouncements of Soviet officials unmistakably pointed at the forthcoming launch. The U.S. government was aware of the Soviet advances, and the American intelligence rather accurately predicted the event.¹ Many infallible media personalities and politicians conveniently chose to remain uninformed, however, and used the opportunity to pin the blame on their political opponents.

Sputnik had shocked the general public in the United States and elsewhere. Many journalists, who did not know much about this specialized subject, tried to explain artificial satellites to their readers. People demanded information about the satellites and spaceflight. Because of the secrecy permeating the Soviet society, little had been ever published on ballistic missiles and space technology outside classified reports. In addition, journalists rarely looked at those few open scientific publications,⁴⁵ which were often too difficult for non-specialists.

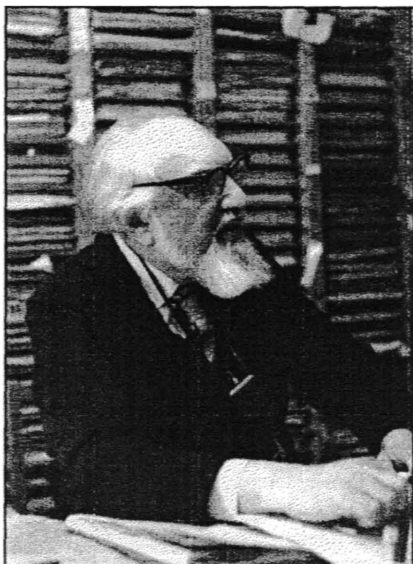
Suddenly, Sternfeld's high-quality popular books became an excellent source explaining the basics of rocketry and spaceflight, orbital properties, satellite visibility from the ground, communications with satellites, and conditions in space, such as vacuum and weightlessness. Moreover, these publications originated from the country that had been the first to launch a

satellite.

Sternfeld's books gained enormous popularity immediately after the launch of *Sputnik*. His *From Artificial Satellites to Interplanetary Travel*⁴⁶ appeared in December 1957, with 100,000 copies printed. In total, almost 600,000 copies of his books were sold in the Soviet Union from 1949 to 1959, and they were translated into 14 languages spoken in the USSR.¹¹ Sternfeld also quickly prepared the second, expanded edition of his book *Artificial Satellites*,³⁴ which appeared (75,000 copies) in 1958. Only in 1957–1958 was this book published in translation in 18 foreign countries: Argentina, Bulgaria, Brazil, Hungary, Greece, Denmark, Egypt, Finland, Japan, Iceland, India, Italy, Mexico, Netherlands, Poland, Romania, the United States, and Yugoslavia.¹¹ Sternfeld's *From Artificial Satellites to Interplanetary Travel*⁴⁶ appeared in translation in Bulgaria, Czechoslovakia, Greece, Italy, Norway, the People's Republic of China, Romania, the United States, and Yugoslavia.¹¹

In total, 39 countries published Sternfeld's books 85 times and in 36 languages.¹¹ In the United States, the government translation service quickly translated his *Artificial Satellites* after the *Sputnik* launch to make it available to scientists and engineers.^{47, 48} Translated compilations of Soviet writings on spaceflight also prominently presented his publications.⁴⁹ People in foreign countries often connected the well-known name of Sternfeld with the space successes of the USSR. In reality, he remained confined to his home office, and the Soviet state never permitted him to contribute to the program. At that time, the true leaders of the Soviet rocketry and space establishment remained behind the curtain of secrecy.¹

Space writings of Ary Sternfeld brought him world recognition. First his University of Nancy bestowed on him a *honoris causa* doctor degree in 1961. He



Left: A.J. Sternfeld in his office in Moscow in late 1960s.

Photo courtesy Maya A. Shternfel'd and Polytechnic Museum

Right: Soviet space pioneer and leading rocket engine designer Valentin P. Glushko (right) congratulates A.J. Sternfeld with his 60th birthday, May 1965, Moscow.

Credit: NPO Energomash, Khimki



was not allowed to go to France, however, to accept the degree nor was he allowed to receive an international award in 1963. He stayed in Moscow. Finally in 1965, the USSR Academy of Sciences awarded Sternfeld a *honoris causa* degree of doctor of technical sciences.¹¹

Despite his international fame, life was never easy for Ary Sternfeld. Vladimir I. Prishchepa, the author of the first book¹¹ about Sternfeld (published in 1987), explained later,

It would be a mistake to think that Shternfel'd accumulated a fortune from royalties from his books. The Soviet Union did not participate in the international copyright agreements. Many years the living conditions [apartment] of Shternfel'd were difficult and not conducive to creative work. In order to work on [problems of] cosmonautics, he had to accept material assistance from his sister living in Poland. Everyday hardships and difficulties have not, however, broken the spirit of the scientist and have not wrecked his personality.³⁶

Almost everything seemed to be stacked against Ary Sternfeld in the Soviet Union.

"It was difficult . . . to include his [Shternfel'd] name in the last edition of the *Great Soviet Encyclopedia*. The scientist did not [formally] qualify [for inclusion] because he had not reached the rank of the member of the Academy of Sciences [of the USSR]. Then the editor of this publication, German Nazarov, obtained signatures [under the petition] of five academicians representing the field of space technology and presented them to Nobel Prize winner [academician Aleksandr M.] Prokhorov, the chief editor [of the encyclopedia]. Prokhorov ordered to include the name of Shternfel'd [in the encyclopedia] without [required] endorsement of the Presidium of the Academy of Sciences."³⁶

Valentin P. Glushko seemed to be the only leader of the Soviet rocket and space establishment who supported Sternfeld. At least, he publicly recognized his contributions. Glushko first met Sternfeld in RNI in the 1930s. Later Glushko became the head of the leading liquid-propellant engine design bureau Energomash in Khimki.¹ It was Glushko who took part and congratulated Sternfeld at the celebration of his 60th anniversary.

It was not easy to publish the first

book¹¹ about Sternfeld—*Ary Sternfeld: A Pioneer of Cosmonautics, 1905–1980*—in 1987. It took a letter campaign by prominent rocketeers to include this book in the plans of the publishing house Nauka of the USSR Academy of Sciences. Even adding a subtitle, "A Pioneer of Cosmonautics," to the book title required another letter campaign.³⁶

Ary J. Sternfeld passed away in Moscow in 1980. The hostility and indifference of Soviet authorities to the scientist who introduced the words *kosmonavtika* and *kosmonavt* to the Russian language continued after his death. Here again, Valentin P. Glushko paid tribute and extended his helping hand. Prishchepa wrote later that,

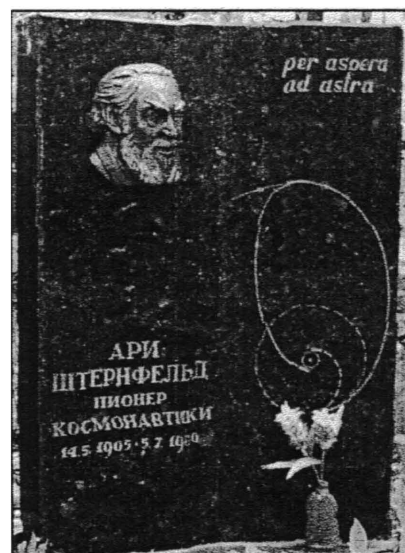
Academician Glushko ordered to provide funds for the [funeral] wreath from our [Energomash] . . . design bureau and participated in the . . . [funeral] procession as part of the [design bureau's] delegation at the . . . cemetery. Official [Soviet] science [establishment] and the authorities did not react to the death of a pioneer of cosmonautics . . . [Presidium of the Academy of Sciences] did not provide funds to put a [common in the USSR] memorial plaque on the house where Shternfel'd lived. His relatives paid for it. But now the Moscow [municipal] authorities held its installation. It was again necessary to collect the signatures [under the petition] and appeal to the wife of M. S. Gorbachev, the patron of culture [in the USSR, in order to install the plaque].³⁶

Sternfeld's tombstone at the Soviet necropolis, Novodevichiye Cemetery in Moscow, shows the engraved trajectory—Sternfeld transfer—to reach a point near the central body and an inscription "Ari Shternfel'd, Pioneer of Cosmonautics".

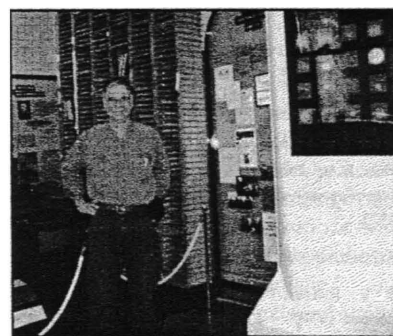
The collapse of the Soviet Union brought many changes. Polytechnic Museum in Moscow holds the personal archive of Ary J. Sternfeld. The museum reconstructed the study room of Sternfeld and exhibits materials about his life and work in one of its halls. Several articles about Sternfeld recently appeared in the Russian media, and Polytechnic Museum published in 2005 a special book commemorating his 100th anniversary.⁵⁰

Acknowledgments

I would like to thank Maya A. Shternfeld, Stella G. Morozova, and Gurgun G. Grigoryan of Polytechnic Museum, Moscow, Russia, and Vladimir Sudakov of



Top: Tombstone at the Novodevichiye Cemetery in Moscow. The inscription reads "Ari Shternfel'd, Pioneer of Cosmonautics." One can see the engraved trajectory—Sternfeld transfer—to reach a point near the central body.



Bottom: The author in the Polytechnic Museum, Moscow (May 2006), next to the reconstructed home study of Ary Sternfeld. Special shelves in the back served for filing numerous materials.

Above photos courtesy Mike Gruntman

Energomash, Khimki, Russia, for help, including photographs, in preparation of this article. My special thanks to Bob Brodsky, Redondo Beach, California, for his comments on the first version of manuscript.

About the Author

Mike Gruntman is professor and chair of astronautics at the University of Southern California (USC). He is the founder of the USC Astronautics Program focusing on degrees in space engineering. Gruntman is actively involved in research and development programs in space science and space technology. He has authored and coauthored more than 200 publications in the areas of astronautics, space physics, space technology, scientific instrumentation, space sen-

sors, astronautical education, and aerospace history. His book *Blazing the Trail: The Early History of Spacecraft and Rocketry*, American Institute of Aeronautics and Astronautics, 2004, received the Luigi Napolitano Award (2006) from the International Academy of Astronautics.

References

1. M. Gruntman, *Blazing the Trail: The Early History of Spacecraft and Rocketry* (Reston, Virginia: AIAA, 2004).
2. W. A. Heflin, "Astronautics," *American Speech* 34 (1961):169–174.
3. R. Esnault-Pelterie, "Considérations sur les résultats d'un allègement indéfini des moteurs," *Journal de Physique Ser. 5*, t. 3 (1913):218–230.
4. E. Touchet, "Assemblée générale annuelle de la Société Astronomique de France," *L'Astronomie. Revue mensuelle d'Astronomie de Météorologie et de Physique du Globe et Bulletin de la Société Astronomique de France*, (June 1927):319–320.
5. P. Greg, *Across the Zodiac: The Story of a Wrecked Record*, volume 1 (London: Trubner and Co., 1880).
6. *L'Astronomie...Supplément au Bulletin* (March 1928).
7. R. Esnault-Pelterie, *L'exploration par Fusées de la Très Haut Atmosphère et la Possibilité des Voyages Interplanétaires*, Société Astronomique de France, Paris, 1928.
8. *L'Astronomie*, (March 1928):120, 140.
9. R. Esnault-Pelterie, *L'Astronautique* (Paris: A. Lahure, 1930).
10. H. Oberth, *Wege zur Raumschiffahrt* (Berlin: R. Oldenbourg, 1929).
11. V. I. Prishchepa and G. P. Dronova, *Ari Shternfel'd: Pioneer Kosmonavtika. 1905–1980* (Ari Shternfel'd: A Pioneer of Cosmonautics. 1905–1980) (Moscow: Nauka, 1987). In Russian.
12. A. A. Shternfel'd, "Istoriya moci pervoi knigi" ("History of My First book"), *Voprosy Istarii Estestvoznaniya i Tekhniki* 3 (1981):134–139. In Russian.
13. L. Rolin, "Utopie d'hier, possibilité d'aujourd'hui," *L'Humanité* (19 August 1930):4; (2 September 1930):4.
14. A. J. Sternfeld, "Les Précurseurs et les Théoriciens de la Cosmonautique," *La Technique Aéronautique* (1935), n.135, 20–28.
15. S. Courtois, N. Werth, J.-L. Panné, A. Paczkowski, K. Bartorek, and J. L. Margolin, *The Black Book of Communism: Crimes, Terror, Repression* (Cambridge, Massachusetts: Harvard University Press, 1999).
16. United States Senate, Senate resolution 150, 109th Congress, 1st Session, 19 May 2005.
17. M. A. Shternfel'd, "Kak nachinalas' russkaya kosmonavtika: Ari Abramovich Shternfel'd—neizvestnyi 'izvestnyi uchenyi'" ("How the Russian Cosmonautics Began: Ari Abramovich Shternfel'd—Unknown 'Known Scientist'"), *Russkaya Kul'tura XX Veka na Rodine i v Emigratsii. Imena. Problemy. Fakty: (Russian Culture of the 20th Century at Home and in Emigration. Names. Problems. Facts)*, issue 2 (Moscow: Moscow State University and Polytechnic Museum, 2002), 27–43. In Russian.
18. A. A. Shternfel'd, "Istoriya Moei Pervoi Knigi" ("History of My First Book"), *A. A. Shternfel'd: Menya Schitalai Neizlechimyim Fantastom... (A. A. Shternfel'd: I Was Considered an Incurable Dreamer...)*, G. G. Grigoryan, editor (Moscow: Polytechnic Museum, 2005), 96–110. In Russian. This is the full text of the article (Reference 12) that appeared in a shortened version in 1981.
19. A. Ya. Shternfel'd, *Vvedenie v Kosmonavtiku (Introduction to Cosmonautics)* (Moscow: ONTI, 1937). In Russian.
20. A. J. Sternfeld, "Méthode de détermination de la trajectoire d'un corps en mouvement dans l'espace interplanétaire par un observateur lié au système mobile," *Comptes Rendus de l'Académie des Sciences (Paris)* (1934):198, 333–334.
21. A. J. Sternfeld, "Sur les trajectoires permettant d'approcher d'un corps attractif central, à partir d'une orbite képlérienne donnée," *Comptes Rendus de l'Académie des Sciences (Paris)* (1934):198, 711–713.
22. A. Hamon, "Communications verbales," *L'Astronomie* (June 1934):277–278.
23. *L'Astronomie* (July 1934):326.
24. A. J. Sternfeld, "Les problèmes de la cosmonautique," *Les Ailes: journal hebdomadaire de la locomotion aérienne* (July 1934): n.683, 4; (26 July 1934): n.684, 7; (2 August 1934): n.685, 4; (9 August 1934): n.686, 4; (7 February 1935): n.712, 4; (28 February 1935): n.715, 4; (28 March 1935): n.719, 5; (6 June 1935): n.729, 4.
25. A. A. Shternfel'd, *Vvedenie v Kosmonavtiku (Introduction to Cosmonautics)*, 2nd edition (Moscow: Nauka, 1974). In Russian.
26. Ya. Perel'man, "Zvezdoplovanie: Shternfel'd A. Ya., Vvedenie v kosmonavtika" ("Star-sailing: Sternfeld A. Ya., Introduction to Cosmonautics"), *Tekhnicheskaya Kniga (Technical Book)* (1938): n. 4, 75–76. In Russian.
27. G. Kramarov, *Na Zare Kosmonavtiki (At the Dawn of Cosmonautics)* (Moscow: Znanie, 1965). In Russian.
28. Ya. I. Perel'man, *Tsiolkovskii: Ego Zhizn', Izobreteniya i Nauchnye Trudy (Tsiolkovsky: His Life, Inventions, and Scientific Works)* (Moscow: GTTI, 1932). In Russian.
29. Ya. I. Perel'man, *Mezhplanetnye Puteshestviya (Interplanetary Travel)*, 10th edition (Leningrad: ONTI, 1935). In Russian.
30. Odnazhdy i Navsegda...*Dokumenty i Lyudi o Sozdaleii Raketnykh Dvigatel'ei i Kosmicheskikh Sistem Akademika Valentina Petrovicha Glushko (Once and Forever... Documents and People about the Developer of Rocket Engines and Space Systems Academician Valentin Petrovich Glushko)* (Moscow: Mashinostroenie, 1998). In Russian.
31. N. G. Chernyshev, *Problema Mezplanetnykh Soobshchenii v Rabotakh K.E. Tsiolkovskogo i Drugikh Otechestvennykh Uchenykh (A Problem of Interplanetary Communications (Travel) in Works of K. E. Tsiolkovsky and Other Scientists of Our Country)* (Moscow: Znanie, 1953).
32. A. A. Shternfel'd, "Astronavtika" ("Astronautics"), *Fizika v Shkole (Physics in School)* (1955): 4, 7–19. In Russian.
33. A. A. Shternfel'd, *Isskustvennye Sputniki Zemli (Artificial Satellites of the Earth)* (Moscow: Gostekhteorizdat, 1956). In Russian.
34. A. A. Shternfel'd, *Isskustvennye Sputniki (Artificial Satellites)* (Moscow: Gostekhteorizdat, 1958). In Russian. This is the expanded second edition of Reference 33.
35. E. Ryabchikov, "Prilunilis" ("Landed on the Moon"), *Pravda* (September 1959):3, 15.
36. V. I. Prishchepa, "Materialy pamyatnei vstrechi k 100-letiyu so dnya rozhdeniya A. A. Shternfel'da" ("Materials of the Memorial Meeting on the Occasion of the 100th Birthday Anniversary of A. A. Shternfel'd"), in Grigoryan, 2005, 123–129. (See Reference 15.)
37. G. Kostyrenko, *Out of the Red Shadows: Anti-Semitism in Stalin's Russia* (New York: Prometheus Books, 1995).
38. G. V. Kostyrenko, ed., *Gosudarstvennyi Antisemitizm v USSR: Ot Nachala Do Kul'minatsii, 1938–1953 (State Anti-Semitism in the USSR: From the Beginning to Culmination, 1938–1953)* (Moscow: Mezhdunarodnyi Fond Demokratia: Materik, 2005).
39. M. A. Shternfel'd, "Portret uchenogo A.A. Shternfel'da" ("A Portrait of Scientist Shternfel'd"), *Istoriya Nauki i Tekhniki (History of Science and Technology)* 8 (2002):20–28. In Russian.
40. "Ob odnoi antipatrioticheskoi gruppe teatral'nykh kritikov" ("On One Anti-patriotic Group of Theater Critics"), *Pravda* editorial (January 1949):3, 28.
41. "Podlye shpiony i ubitsy pod maskoi professorov-doktorov" ("Ignoble Spies and Murderers under the Mask of Professors-Medical Doctors"), *Pravda* editorial (January 1953):3, 13.
42. N. Chernyshev, "Neskol'ko slov ob odnom 'laureate'" ("A Few Words about One 'Laurate'"), *Kul'tura i Zhizn' (Culture and Life)* (January 1951):4, 31. In Russian.
43. S. G. Morozova, "Nekotorye fakty iz biografii uchenogo" ("Some Facts from the Biography of the Scientist"), in Grigoryan, 2005, 129–137.
44. A. A. Shternfel'd, *Mezhplanetnye Polyoty (Interplanetary Travel)* (Moscow: Gostekhteorizdat, 1955; 2nd ed. in 1956). In Russian.
45. *Uspekhi Fizicheskikh Nauk (Successes of Physical Sciences)*, Vol. 63, N.1a (1957).
46. A. A. Shternfel'd, *Ot Isskustvennykh Sputnikov k Mezplanetnym Polyotam (From Artificial Satellites to Interplanetary Travel)* (Moscow: Gostekhteorizdat, 1957). In Russian.
47. A. Shternfel'd, *Artificial Satellites (Isskustvennye Sputniki)*, F-TS-9570-V (translation prepared by Technical Documents Liaison Office, MCLTD, Wright-Patterson Air Force Base, Ohio) (Washington, DC: U.S. Dept. of Commerce, 1958).
48. A. Shternfeld, *Soviet Space Science* (New York: Basic Books, 1959).
49. A. A. Shternfel'd, "From Earth Satellites to Interplanetary Travel," *Soviet Writings on Earth Satellites and Space Travel* (New York: Citadel Press, 1958), 13–154.
50. A. A. Shternfel'd, *Menya Schitalai Neizlechimyim Fantastom... (A. A. Shternfel'd: I Was Considered an Incurable Dreamer...)*, G. G. Grigoryan, editor, (Moscow: Polytechnic Museum, 2005. In Russian.