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Cultivating the cosmos: spaceflight thought in Imperial Germany

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Space historians have predominantly identified Weimar Germany (1919–1933) as the starting period of German debates over the possibility of spaceflight. However, spaceflight and the utopian potential of outer space were already topics of popular discussion in the late nineteenth century, when calls by German astronomers for speculative restraint were challenged in popular science accounts and fantasy literature. Mass-produced fiction in the first decade of the twentieth century increasingly depicted spaceflight as a technological vision, imagining the spaceship as the successor to the airship. While exploring the historical processes behind this ascent of plausibility of futuristic design, the article shows how popular science media gave public voice to both established and new professional elites and fostered interprofessional exchange. In the 1900s spaceflight developed into a popular theme and boundaries between fiction and popular science blurred.

Keywords: popular astronomy; spaceflight fiction; plausibility; disenchantment; speculation

On 27 May 1891 the Berlin-based inventor Hermann Ganswindt (1856–1934) announced in the Berlin Philharmonie concert hall that he had 'discovered the solution to the problem of an expedition to other celestial bodies.'[1] Ganswindt, facetiously referred to as the 'Edison of Schöneberg' by some, proceeded to present a spaceship design based on reaction propulsion – something the audience had not heard of before and that deviated considerably from Jules Verne's bullet-shaped Moon craft in *De la terre à la lune* [From the Earth to the Moon] and *Autour de la lune* [Around the Moon].[2] Just a few kilometers away at the Berlin Urania, an industry-funded society that popularized scientific knowledge, director Max Wilhelm Meyer (1853–1910) also commented on the possibility of spaceflight during his popular astronomy presentation *Von der Erde bis zum Monde* [From the Earth to the Moon] that he had regularly performed since 1889. However, as a scientist he insisted that the journey to the moon could just 'be an imagined one, because there is no way, and there will never be a way to get our clumsy bodies from this clod of Earth, which pulls us down all the time, up to the flickering stars, whose shine hits our longing eyes like other great mysteries from the infinity.' Two decades after the first publication of Jules Verne's influential works, this fundamental disagreement signaled the beginning of a dispute over the feasibility of spaceflight in Germany. While this conflict of opinion was initially marked by tensions between popular science and engineering fantasies, cheaply mass-produced fiction seized on the spaceflight topic in the 1900s. It won over the popular imagination while favoring ideas of technological innovation and establishing notions

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of spaceflight plausibility through concepts of the spaceship. This article explores the circumstances in which spaceflight became a plausible vision of the future based on technology in *fin-de-siècle* Germany.

Since Frank Winter's book Prelude to the Space Age (1983), the Weimar Republic has come into the focus of historical research on spaceflight not only as the period in which liquid propulsion rocket research started in Germany. It has also been identified as the period of an early professional and popular spaceflight enthusiasm that not only led to military development and the Nazi V-2 rocket, fired on London and Antwerp, but also indirectly shaped the American and Soviet space programs through transfers of equipment, knowledge and professionals after the war.[3] In the light of this history of technological realization it has been difficult to regard earlier spaceflight imagination, widely known in the form of space fiction such as Kurd Lasswitz's *Auf zwei Planeten* [On Two Planets] (1897), as more than fantastic precursors. Likewise, space historians have often portrayed Ganswindt's 1890s proposal as a peculiar case, ahead of its time and therefore ahead of modern space history that in the German context is usually traced back to Hermann Oberth's *Die Rakete zu den Planetenräumen* [The Rocket into Planetary Space] (1923). This interpretation dates back to the late 1920s and 1930s and to books such as Willy Ley's *Die Möglichkeit der Weltraumfahrt* [The Possibility of Spaceflight] (1928), Werner Brügel's *Männer der Rakete* [Men of the Rocket] (1933) and Charles Philp's *Stratosphere and Rocket Flight* (1935).[4] Members of the Weimar and international spaceflight enthusiast movements started writing their own history at the same time their societies emerged and sought funding for their proposals. While the movements became increasingly international, early historians of spaceflight assembled lists of the various countries' pioneers – Konstantin Tsiolkovskii (Russia), Robert Esnault-Pelterie (France), Robert Goddard (USA), Hermann Oberth (Germany) – and outlined the spaceflight idea as a transnational phenomenon. Yet, in all these different societies and cultures there were sometimes distinct, sometimes intertwined, but always specific cultural developments that preceded the actual Space Age. The term 'astroculture' is employed here to take into account the various forms of discussion and knowledge about the cosmos. It sheds light on outer space as a cultural phenomenon and traces how it interacted with other ideas, images, practices and socio-cultural developments that might initially appear to be unrelated.[5]

While there were no rocket societies or sensational experiments before the late 1920s, a European exchange of ideas about spaceflight already took place through fiction. The appropriation and discussion of these ideas primarily happened on local and national levels. This article focuses on Germany and the generation of actors that preceded the enthusiasts of the Weimar years, and takes into account the history of astronomy, the German professions, and science fiction. It argues that in the two decades before World War I German depictions of spaceflight underwent a pivotal shift from fantastic plots to speculation about its technological feasibility. Several motifs, modes and the media of distribution that were established around 1900 characterized German popular spaceflight thought until the mid-twentieth century.

Popular astronomy conveyed scientific knowledge, while spaceflight fiction displayed fantasies about technological innovation and future potentials. However, it is crucial to analyze the relation between the two. Roger Cooter and Stephen Pumfrey have stressed the contingency of the connection of popularized science and popular belief, even though the first was usually deployed against the latter.[6] This relation was particularly complicated in the early phase of modern astroculture. While astronomers aimed at disenchanting popular fantasies, they defended the cosmos as a sublime, even transcendental

sphere out of technological reach. Space fiction authors, in contrast, propagated scientific openness towards future possibilities. While a practical technoscience, a sociotechnical conflation of science and industrial organization as defined by Bruno Latour, cannot be identified in regard to outer space in Imperial Germany, aspects of technology and science already began to merge within fiction.[7] This new correlation brought the earthbound into the focus of astroculture: notions of the outgoing triumphed over the incoming (e.g. aliens invading Earth), and the cosmos became a place of potential and a controllable space of human action.

Disenchantment was not only a cultural process of decrease or decay of traditional belief in myth, an 'Entzauberung der Welt' [disenchantment of the world] in the words of Max Weber.[8] It also appeared as a rhetorical tool and expression of disillusionment that became a practice of professional distinction. Both popular astronomy and popular fiction stressed their 'Wissenschaftlichkeit' (scholarliness) to demonstrate scientific rigor and validate their claims to delineate scientific and technological plausibility.[9] While in the 1900s mass-produced fiction highlighted the potentials of progress, astronomers reacted by explicitly differentiating between transcendental aspects and scientific reasoning. This enabled them to carefully complement both in popular science, to allow speculation and to deploy transcendental aspects and even references to remote utopias against allegedly unsophisticated visions of technology in fiction.

Narratives always had a specific historical context in which they were produced and understood. Therefore, this article does not explore the realism, but the plausibility of speculative design and the future vision of spaceflight in the decades preceding World War I. This plausibility depended neither on the method and outcome of experiments, nor was it merely a literary phenomenon. It was contingent on the argumentation regarding the various assumptions technology visions were based on, the cultural context of the production of these concepts, and the social and professional background of producers and recipients. While ideas of spaceflight feasibility were first established in fiction, this new genre of space fiction featured close correlation with popular scientific and technological knowledge in both discourse and the practice of publication. Spaceflight short stories were often published in the same youth and technology magazines that featured articles on existing technologies and recent advances in science. Narrative verisimilitude, as identified by Tzvetan Todorov as important to the plausibility of fictional character actions, was an essential, but not the only source of notions of feasibility.[10] At all times societal factors interwove with narrative arguments and inherent depictions of histories of the future. In particular, the process of spaceflight becoming feasible was the outcome of a specific intertwining of notions of progress in aeronautics and machinery on the one hand and fantasy literature about new frontiers that eluded mapping on the other. New ideas were related to the ascent of new media such as technology magazines and to social and inter-professional developments among engineers, science journalists, and writers of fiction.

Popular astronomy and the limits of scientific knowledge

Speculation about alien life, extraterrestrial communication, and the possibility of spaceflight were not prominent in popular books by German astronomers in the late nineteenth century. This seems peculiar since, as Steve Dick has noted, potential life on other planets had constantly been debated in science and theology from at least the late seventeenth to the early nineteenth century.[11] In 1822, Karl Friedrich Gauss (1777–1855) proposed attempting to communicate with extraterrestrials by employing a large heliotrope, a system

of mirrors reflecting sunlight. In the same year, the Munich astronomer Franz von Paula Gruithuisen (1774–1852) claimed he had observed a city in a Moon crater, causing a significant stir at the time.[12] In the second half of the nineteenth century, however, astronomers were much more careful about public speculation about life on other planets. Authors most often took a page from Hermann Joseph Klein (1844–1914) (in his much-reprinted *Astronomische Abende*) or Rudolf Wolf (1816–1893) (in his 1892 *Handbuch der Astronomie*) by neglecting to mention the possibility of alien life or space travel at all. [13]

In 1852, Johann Schmitz described astronomy as the 'safest guide to exploring the secrets of nature,' but deplored that the discipline had gone astray in a 'labyrinth of alleged immaterial forces of nature.' In order to relate it to observations in the other sciences, astronomers had adulterated the pure mathematics of their discipline. New theories were hardly exact and became frequently outdated with new findings. Therefore, Schmitz reasoned, astronomy had to return to careful observing, measuring and calculating.[14] His argument against speculation notably deviated from Alexander von Humboldt's (1769–1859) approach to connect all sciences in an overview of modern knowledge, influentially propagated in his *Kosmos* series (1845–62).[15] Identifying the relational approach as a misleading one, Schmitz argued for the disenchantment and modernization of astronomy.

The increasing knowledge of the vast distances in the solar system prompted doubt about the feasibility of achieving spaceflight and communication with extraterrestrials. Astronomers were especially careful about speculation regarding Mars, although knowledge of the red planet was much more limited than knowledge of the Moon had been a hundred years earlier.[16] Michael Crowe has shown that belief in alien civilizations also declined because of the development of biological science and knowledge about the complex conditions necessary for sustaining life.[17] However, that had not put an end to speculation as a whole.

It is important to take into account the specific historical context of larger debates about scientific theory in the second half of the nineteenth century. As Andreas Daum has pointed out, speculation became a topic of contention among scientists and politicians especially in the years following the unification of Germany into a nation state of 1871. Leading scholars and the German parliament in Berlin debated whether speculative theories in science teaching, particularly Darwinism, could foster socialism and atheistic tendencies among students. In 1879, The German government took a liberal stance and decided both that scientific debate was open and independent, and that it was not the state's role to penalize 'wrong' scientific thought, although it also concluded that unproven scientific hypotheses, such as Darwinism, should not be taught in school.[18]

While the debate reflected and augmented a general call for objectivity and speculative restraint among scientists, astronomy was found to be an ideal counterpart to speculative theory in school curriculums. In 1875 and 1876, both the general and specialized press welcomed German translations of Norman Lockyer's *Primer of Astronomy* and *Macmillan's Science Primers*, edited by Sir Thomas Huxley, which included a volume on astronomy. The understandable yet sophisticated style of British popular science impressed commentators and inspired German schoolbook writers to follow suit.[19] In 1877, the physicist Emil Jochmann (1833–1871) and the mathematician Oswald Hermes (1826–1909) augmented their hugely successful *Grundriss der Experimentalphysik* for secondary schools with a section on astronomy, the pedagogue Eduard Wetzel worked his comprehensive *Allgemeine Himmelskunde* for teachers into a slim volume for pupils, and Hermes's *Elemente der Astronomie* had appeared in 1876.[20]

With their rejection of speculation about extraterrestrial life, astronomers also turned against new forms of spiritualism that transgressed the borders between religion and science. In *La pluralité des mondes habités* [The Plurality of Inhabited Worlds] of 1862 the French astronomer Camille Flammarion had supported the (much older) theological argument that the universe had to be full of inhabited planets since an empty universe could hardly make sense in the light of religious reasoning, thus propagating alien life as a topic of popular science.[21] In 1881, the German theologist Joseph Pohle published *Die Sternwelten und ihre Bewohner* [The Stars and Their Inhabitants], a 124-page essay on the possibility of inhabited worlds, in the journal of the Görres-Gesellschaft, a Catholic society for the advancement of science that had been founded in Koblenz in 1876. Pohle complained about the ignorance and unwillingness of German scientists to actually engage in that discussion and identified a general fatigue among them as 'the alp that oppresses German speculation.' As professor of theology at the seminary in Leeds at the time, he praised the greater openness of his British colleagues.[22] By referring to the well-respected British science system, Pohle highlighted an alternative approach and put the German customs into perspective.

Because of the competition between popularizers of different professional backgrounds on the German book market, especially school teachers, academics and professional writers, the astronomers' predominance over the popular interpretation of outer space was increasingly challenged.[23] Thematically, the German astronomers were also confronted with fiction about extraterrestrials and ideas of reaching outer space through engineering. Technology played a key role in Jules Verne's *De la terre à la lune* and the sequel *Autour de la lune*, both translated into German in 1874.[24] The former was about a fictional American 'Gun Club' building a gigantic cannon and successfully shooting three people into space. The sequel told readers of a failed Moon landing and the crew's return to Earth. Although based on accurate calculations of technical details like the necessary escape velocity or the best launching site (Florida), the story was primarily a fantastic tale of adventure.

The idea of extraterrestrial life was a central feature of the British novel *Across the Zodiac* by Greg Percy, published in German in 1882. It told the story of a trip to an inhabited Mars by an engineer via anti-gravitation drive, a technology that became the means of choice in science fiction novels for at least two decades.[25] The Martian society the traveller discovers is logically constructed, but not perfect. Percy's novel marked a shift of interest from the planet Venus to Mars. Earlier imagination had often looked at Venus, but the supposed discovery of 'Martian canals' by the Italian astronomer Giovanni Schiaparelli in 1877 drew public attention to Mars. These canals were later identified as natural structures and optical illusions owing to the limitations of the telescope at that time, but the phenomenon served to underpin narratives about alien life on the planet up until the mid-twentieth century. It has often been argued, most notably by the science publicist Willy Ley, that 'Schiaparelli's first announcement was followed by three decades of Mars enthusiasm,' even in astronomical circles.[26] However, at least in the first two decades after their discovery, German scientists' reactions to the phenomena were rather reserved. Even Schiaparelli himself emphasized in 1889 that his newest and more detailed findings should be 'able to restrain the upswing of our imagination.'[27]

The combination of fantasies about technology and ideas of inhabited worlds in outer space presented a problem to the popularization of astronomy as both were based on unproven speculations. In times of higher literacy rates, a growing book market and fiction that tried to include common scientific knowledge, it became an act of professional legitimacy to challenge popular fantasies. Nevertheless, popular science also played a key

role in making the cosmos tangible. To examine the complex relation between rejecting technology and rationalizing and spatializing outer space, the new popular science institutions and public presentations of around 1890 have to be taken into account.

With its universities, such as the Friedrich-Wilhelms-Universität and the Technische Hochschule, its many libraries, museums and scientific institutions, Berlin was not only the capital of Imperial Germany, but also one of its major places for research, higher education and the popularization of science. The latter was institutionalized by private societies such as the Urania which provided public access to an observatory, exhibitions and presentations. Max Wilhelm Meyer (1853–1910) founded the society in 1888 together with the astronomer Wilhelm Förster (1832–1921) and became its first director.[28] Meyer had already written popular articles for the *Berliner Tageblatt* from 1885 onwards and went on to publish books and speeches that introduced lay audiences to astronomy. The immensely popular Urania show *Von der Erde bis zum Monde*, first staged in 1889, consisted not only of Meyer's talk, but was accompanied by spectacular visuals, embedded in a virtual tour from rural Brandenburg to the Moon and back. Large drawings gave new perspectives on the solar eclipse of 1887, particularly from the lunar surface (Figure 1).

The science theater, a forerunner of the projection planetarium, was realized by employing set decorations and an elaborate electrical lighting system. In 1892 the show toured Budapest, Vienna, Paris, and even New York City, where it was shown in the newly opened Carnegie Hall. Since observatories alone had often left visitors unsatisfied or even disappointed, the science theater aimed at connecting educational and entertainment elements.[29] The shows were also explicitly meant as a key strategy in making the Urania financially successful.[30] However, while they were supposed to create a pleasurable experience, disappointment had not just been the outcome of a conflict of expecta-

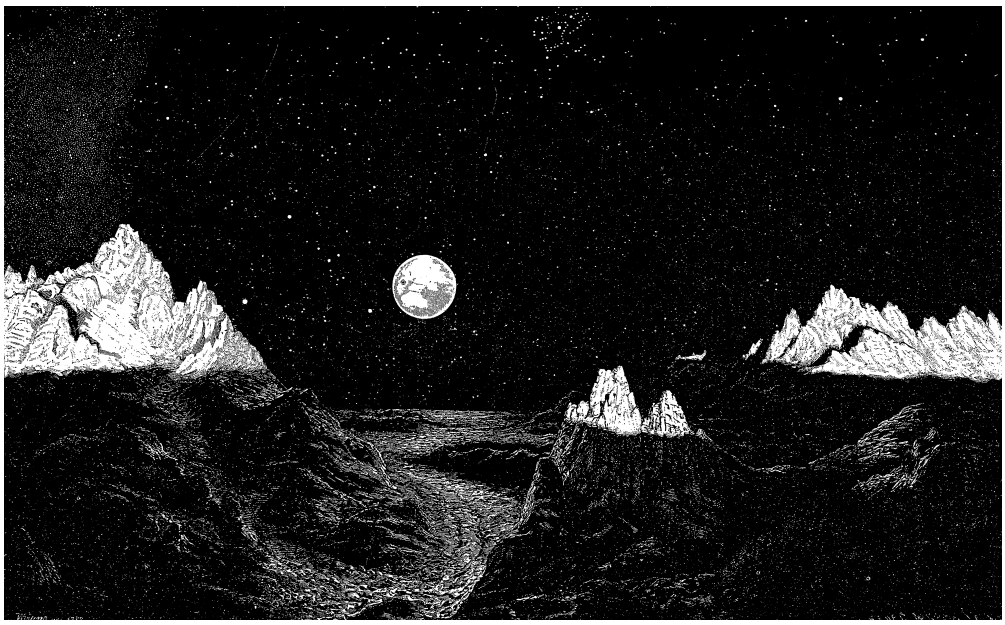

Figure 1. Drawing of the lunar surface by *Urania*'s designer and stage director Wilhelm Kranz (1853–1930). Kranz's illustrations were used in Max Wilhelm Meyer's lectures and offered visitors of the science theater new and sometimes extraterrestrial perspectives on phenomena such as a solar eclipse.
Source: *Himmel und Erde* 1, no. 1 (1889): 4.

tions of scientists and visitors. Disillusionment rather became an essential practice in teaching science to the public.

Meyer emphasized that space travel could be an intellectual adventure only and repeatedly called for a serious approach:

> We can make the announced tour from the Earth to the Moon, the next station in space, and back to where we started only in our mind. However, we will see with satisfaction that our mind, if we do not expose it to ridiculous fantasy, will be a safe guide through extraterrestrial spaces, one we can confide in.[31]

From the onset, Meyer prepared viewers to expect a scientific presentation that did not address popular fancies. At the same time, while it rejected notions of spaceflight through technology, *Von der Erde bis zum Monde* was one of the first virtual journeys into outer space. Therefore, it gave lay audiences the opportunity to visually experience leaving Earth and changing the perspective on their planet.

As Charlotte Bigg has pointed out, Meyer was critical on the prevalent positivism and the dominance of pure mathematics in astronomy, just like many of his fellow celebrity astronomers in Germany and Europe such as Lockyer and Flammarion.[32] The Urania was meant to overcome this isolation of knowledge and lack of imagination by presenting and relating findings from different disciplines in keeping with Humboldtian ideals. At the same time, as Ole Molvig has shown, the Urania's founders strove to elevate the standing of science as a public enterprise and therefore present it as a serious and professional business worthy of investment. While the German government had decided on a liberal stance in the 1870s, scientists faced difficulties in demonstrating the common benefits of science and securing continuous state funding. Werner von Siemens (1816–1892), one of the Urania's main sponsors, lamented that even Otto von Bismarck (1815–1898), prime minister of Prussia and German chancellor, considered the natural sciences expensive, elite activities with little public relevance.[33]

The Urania's double objective of popularizing science and displaying professionalism was a difficult task, but no contradiction: particularly the turn against speculative mathematics signaled a shift in the evaluation of what kinds of speculation were acceptable or even desirable in popular representations. While pure mathematics seemed unrelated to the everyday, imagination gradually became accepted up to specific limits that were regularly reassured and demarcated by expressions of disillusionment. The double objective also had economic reasons: the professionalization aspect was meant to encourage the growing middle class to invest in the sciences, while the popularization effort approached it as consumers.[34] Consequently, the Urania legitimized the teaching of science to the public as separate from the practice of science.[35] As the popularizer Meyer, the practicing astronomer Förster, and the industrialist Siemens formed a partnership that was of mutual benefit, the Urania became a mediator between different actors and interests.[36] While the sciences could remain independent and become even more specialized, the now externalized popularization effort grew crucial to secure their distinguished position by demonstrating their public service.

At the same time Max Wilhelm Meyer tried his best to invalidate fiction fantasies, an increasing amount of general popular science accounts in the 1890s more eagerly connected the imagination of outer space with ideas in other fields, particularly religion and education. Often based on Flammarion, they discussed ideas of extraterrestrial life more positively while at the same time professing scientific objectivity. In this way they rhetorically mediated between science and fiction and justified extensive speculation in popular

science. In his *Die Welt des Irrthums* philosopher Adolf Brodbeck (1853–1930) explained that many ideas of popular science were in fact unscientific. He argued in regard to astronomy that it was 'a falsity to believe there are human beings living on other planets or even stars, which are suns.'[37] Only after having distanced himself from that popular thought did he admit that it is 'more than probable that our Earth is not the only celestial body that is inhabited by organisms,' and even that humans or manlike beings could live on Venus or Mars, but not on the Moon.[38] Brodbeck employed these postulations of *Wissenschaftlichkeit* (scholarliness) to promote a new religious consciousness that did not contradict modern science: 'Quite the contrary: both have to be compatible with one another.'[39]

The pedagogue Friedrich Gustav Ludwig Gressler, solely known for his much-reprinted popular books on astronomy and geography, employed the idea of a transcendent cosmos and the imagination it evoked to propose change and alternatives in pedagogics. In his schoolbook *Himmel und Erde* he argued:

> But even simple fiction which guides us through the skies and to planets, comets, and suns, is not condemnable. They involve the most worthy and noble ideas, they elevate and purify us. Their validity increases, and they become most educational when they are based on cognition and mathematical facts; and often perceptions have been proven right by discoveries; sometimes they even lead us to discoveries.[40]

This defense of fiction also meant a defense of speculation as legitimate and scientific. The argument was not based on the idea that scientific 'truth' had to be disseminated among students, but turned it around. Education, not just knowledge, as the central parameter and practical goal justified the combination, even conciliation of modern science and traditional morale. Angela Schwarz has pointed out that popular science played a double role in German and British modernization processes. It was regarded as both a cause for the chaos of modernization and a key tool in its explanation and overcoming by creating a new order.[41] However, rather than elevating science to a new order, Gressler reinterpreted its function and scope by situating it in the context of education and in relation to speculation.

He started by speculating himself, in astounding detail, on the possible appearance of life-forms on moons, planets and suns. His thoughts on life on the sun specifically involved spiritual concepts. Inhabitants of the sun were 'creatures of the higher or fourth kingdom of nature,' had six or more senses and were in many respects superior to humans, but the latter had the same 'divine spark' and inner potential to eventually 'ascend towards higher regions.'[42] In a self-reflective vein, Gressler reasoned how this potential could be unleashed by teaching astronomy.

> No lesson affects the young mind as forcefully and as holistically. It toughens the body, sharpens the senses, trains the memory, feeds the fantasy with the most precious images, trains the intellect, dispels all pettiness, and causes a solid base for the deepest trust in God. It gives the only right benchmark for the value of life, and even alleviates dying.[43]

While depicting astronomy as a wondrous tool to make young people perfectly and holistically educated and trained adults, Gressler also used spiritual concepts to endorse pedagogic reform and postulated new ways of learning and teaching, marked by student-activity.

Even after having left the Urania in 1897, Max Wilhelm Meyer continued to oppose this blurring of intentions and the increasing amount of speculation particularly about

extraterrestrial life. Having spent almost 15 pages on discussing the Martian canals in *Das Weltgebäude* in 1898, Meyer pointed out that aliens could not have built the canals, disregarding fantastic speculation as a potential for scientific explanation:

> Such forces and creatures would be incomprehensible to us; you can prove anything and therefore nothing with them. We would not even think about it if certain parties had not considered in earnest these still supernatural arguments. But to explain things that you do not understand with something you cannot understand means to oversimplify it.[44]

In Meyer's view, concepts of alien alterity were beyond any scientific approach. At the same time, he employed this rejection of speculation to explain a rather earthbound otherness. Fantasies about the stars, *Das Weltgebäude* read, were a characteristic of 'primitive' human beings who might have a comprehensive knowledge of the stars and their constellations insofar as they are visible to the naked eye: 'It is a fact that the bushman, a really miserable being that is not even capable of building a cabin, can orientate himself under the stars much better than hundreds of thousands of our educated metropolitans,' but, according to Meyer, only the scientific observation of the stars could be 'civilized.'[45] He connected the idea of cultural advancement not to notions of progress, but rather to the limits of knowledge. This call for academic austerity, for understanding science as the identification of new boundaries rather than seeing possibilities for speculation, meant a turn against the re-enchantment of the cosmos and the connection of modern myth and science by popular science writers on the one hand, and a rejection of prophecies of long-term progress and oversimplifying concepts of outer space in fiction on the other. As a result of the growing popular science market at the end of the nineteenth and the early twentieth century astronomers did not lose their authority, but their predominance over the popular interpretation of outer space.

In the 1900s, these confrontations became blurred and the arguments shifted. While astronomers came to accept speculation, as we will see later, alien life never played a continuous or constant role in German debates until the 1950s. Particularly in fiction, the focus shifted to technology. Spaceflight and inhabited worlds in space became separate topics of astroculture. Radical alterity was not an apposite motif in technology fiction that was largely written by engineers-turned-writers such as Hans Dominik (1872–1945) and that told of futuristic outlooks within a generational reach. Four decades later, the major disaster of World War II shook belief in linear progress in its foundations, and engineering dreams became negotiable again. The 1950s also saw an increase in the sheer amount of space fiction, and a growing transnational science fiction market caused an increasing diversity in terms of authors and ideas. The first half of the twentieth century can thus be identified as a period in which engineers predominated the popular interpretation of the future in Germany. Around 1900 outer space became an ideal motif for showing how technology alone could open up new possibilities for human societies. While the potential for setbacks was generally acknowledged, the belief in technological feasibility remained undaunted. At first, however, this notion of future innovation continued to be constrained to its very medium of fiction, and the spaceship was not yet plausible as an engineering concept when Hermann Ganswindt presented his 'Weltenfahrzeug' in 1891.

Implausible engineering

The supposedly most obvious solution to the space travel problem, rocket technology, was not seriously considered as a form of transport by German technicians and scientists

Figure 2. Drawing of Hermann Ganswindt (1856–1934) from his 1899 publication *Das jüngste Gericht*. The book was not only meant to inform laypeople, journalists and state authorities of his diverse inventions, but also to foster his renown as a visionary engineer.
Source: Ganswindt, *Das jüngste Gericht*, 1.

before the 1920s. Writers of fiction preferred the employment of more futuristic technologies powering their imagined spaceships. Although small circles of French and Russian mathematicians and engineering theorists discussed Robert Esnault-Pelterie's and Konstantin Tsiolkovskii's spaceflight proposals as early as the late 1900s and early 1910s, those debates were noticed in Germany only much later, particularly through the works of Nikolai Rynin, Alexander Shershevskii, and Willy Ley in the late 1920s and early 1930s.[46] Mostly considered old technology in the second half of the nineteenth century, rockets were too loud, too clumsy and too imprecise to be a technology of the future, unlike the calm, weightless and floating airship.

The powder rocket was widely known, but was small, did not reach high altitudes, and often was an object of humor and pleasure.[47] The association probably sprung from the firework-rocket and its impressive explosion, a striking symbol for an ironic punchline. Rockets were also part of systems for castaway rescue or harpoons, or known as the Congreve rocket weapon that had long been outperformed by modern artillery.[48] Seldom was rocket technology used in new inventions.[49] The background of themes for early German notions of space travel were rather the advent of flight and a professional, institutional and later also popular enthusiasm for aviation and the dirigible in particular. However, notions of futuristic technologies were not just ignored or dismissed by astronomers. Proposals for flying machines were often explicitly ridiculed and rejected by public officials in reference to fiction. While Verne's idea of a manned bullet flight was

noticed as being impractical, his name became a prominent synonym for wild, fantastic notions of technology. When in 1894 the Prussian military initially declined to fund Count Zeppelin's airship designs, an officer summarized all his skepticism on the official document with the simple marginal comment 'Jules Verne.'[50]

Hermann Ganswindt's presentation of 1891 in the Berlin Philharmonie appears as the only case in which space travel was proposed publicly as an engineering project in Imperial Germany. However, space historians have had problems categorizing his relevance. He was not a prophet of the future like the science fiction authors, but he was also 'not one of the great pioneers of astronautics,' as Gordon Thompson of the British Interplanetary Society pointed out 66 years later. His ideas were neither fantastic nor practical enough to be either. Thompson concluded that his 'place in the history of spaceflight' was 'being one of the first to think seriously' about it.[51] In that way he accepted thought as a benchmark of relevance, but it remained difficult to determine its historical relation to later technological successes.

As a non-industrial producer, known for his freewheel bicycles and futuristic ideas of airships, helicopters, and motors, Ganswindt was dependent on word of mouth to find customers, so he placed small ads in local magazines in which he invited readers to come to his workshop and watch demonstrations of sensational devices, especially flying machines.[52] He also arranged presentations in concert halls and at festivals or conventions, where he mostly spoke about his concept of a dirigible airship. Ganswindt connected his speeches with musical entertainment in order to attract listeners and to justify entrance fees.[53]

Ganswindt's presentation on 27 May 1891 was one of these events in which the Berlin inventor not only explained 'the most urgent problems of mankind,' but also presented his technological solutions. After describing the 'enemies of the future,' particularly Napoleon, who had not believed in the success of the steamship, the inventor explicated the possibility of space travel:

> Yes, it is possible not just to remain in the air by the means of wings. While prejudice is still laughing about the solution to this problem, … I have already found a way to remain in empty space and, therefore, discovered the solution to the problem of an expedition to other celestial bodies.[54]

His design was meant to work with dynamite cartridges that explode in a chamber and put a spacecraft into motion. Heinz Gartmann later commented, 'Impetuous as ever, Ganswindt had over-reached himself in trying to combine his brilliant ideas with wild prophecies far beyond the comprehension of the listeners,' but that was only part of the reason why his 'Weltenfahrzeug' was of little influence.[55] First, the speech deviated from technological discussion to speculation about aliens and the reconstitution of human bodies on other planets after death. Ganswindt did not explain the mathematics behind his project.[56] Second, he did not present any plan or announced experiments, as he did with his other inventions. Ganswindt explicitly dismissed the idea that the reaction principle could be used efficiently on Earth. While the decades old dirigible idea seemed the next step in the conquest of the air after the balloon, the spaceship first appeared as a fictional device. Ganswindt's idea of a flying machine that was supposed to work in the same way as funfair rockets did not intersect with notions of modern aviation.

While the local press mostly focused on Ganswindt's practical inventions and the workshop exhibition he established in Berlin–Schöneberg, it was the spaceship concept that made him known beyond the German capital in the long term. The middle-class

entertainment magazine *Deutsche illustrirte Familien- und Moden-Zeitung* in 1899 compared Ganswindt's spaceship with existing technologies and the prospect of spaceflight to Columbus's adventures in America:

> Life support in this coupé, which is comfortably heated from the outside, is indeed not more difficult than in a submarine, which of course already exists, and transports air in steel tanks. … Ganswindt for example … has calculated that one could safely reach Mars in about 22 hours. And where theory is based on physics, people will start working on the realization soon. Even in the Middle Ages, Columbus was able to reach America, although his contemporaries regarded that trip as lunacy.[57]

By using these comparisons the article historicized progress and optimistically pictured the endeavor of spaceflight as possible. However, the article argued that the vehicle should first be used for travel on Earth: 'We do not feel like imitating those dislikeable people who exhibit objections to the spaceship. It does not need to go to Mars or Venus, anyway; it would be enough if it could establish express routes between continents first.'[58] The argument highlighted the technology's practical application to demonstrate its likelihood of being a future project.

The Austrian engineer Roman Gostkowski, professor at the Technical University of Lemberg and renowned for a popular book on railroad mechanics, in 1900 concluded in the Viennese magazine *Die Zeit*:

> Icarus is not dead! He lives in Schöneberg near Berlin …. He wants to cross the atmosphere and travel through the endless outer space! That, however, is a theoretical pipe dream that vanishes into thin air if analyzed in the light of everyday facts. … This is how we talk, but we keep forgetting that it is just the arrogance of our lack of knowledge that lets us regard as impossible what we do not understand.[59]

Immediately after stating that it was not possible, Gostkowski cast doubt over the reason for being so hasty in his rejection. Still, he concluded with inaccurate assumptions that Ganswindt's dream was nothing more than fantastic since the reaction principle could not work in outer space. One month later the engineer Ludwig Loos answered in the same magazine that the rocket problem was much more fundamental: it could not work because no explosive could provide enough propulsion for entry into space.[60]

Ganswindt's spaceflight idea achieved retrospective fame, but was of little influence in Imperial Germany. The 1920s spaceflight fad was marked by the combined influence of scientists, journalists and engineers in Weimar Germany.[61] Ganswindt had no access to networks of expert peers or influential friends, and his spaceship was a thought experiment that he did not pursue any further. While in the 1890s spaceflight was a common theme of fiction, his spaceship did not appear plausible as an engineering project. Plausibility was at all times limited to a specific context, but also depended on who proposed an idea. Ganswindt's public authority, however, was rather constrained. While his family wanted him to become a lawyer, Ganswindt was more interested in engineering, left university without a degree and became a freelance inventor. Although the engineering profession made considerable gains in social status in the late nineteenth century, the standing of freelance inventors was far from that of the traditional elites. Ganswindt suffered from low esteem throughout his life.[62] A success with his bicycles and drawing hundreds of listeners to his speeches, he won supporters and friends within technology enthusiast circles, but also had numerous enemies within the Prussian administration, in universities, and among press publishers. Ganswindt was charged for fraud in regard to a

helicopter demonstration and imprisoned on remand for two months in 1902. Although he was acquitted of deliberate fraud, he never lost the reputation as a crook. Newspapers refused to print his ads, and his posters were taken down.[63]

Ganswindt's detractors opposed him for several reasons. On the one hand, as an inventor he had little reputation, but turned skeptical journalists away and spoke with and about academics very deprecatingly.[64] On the other hand, Ganswindt used his public speeches to raise money for his inventions, and the feeling of having been deceived prevailed among viewers after Ganswindt made slower progress with his sensational inventions than his full-bodied proposals had promised. Skepticism turned into disillusionment and killed all elation. Sensationalism worked as a tool to attain resources while he failed to acquire state funding, but when his reputation was gone, Ganswindt's work lost its socio-economic basis.[65] The third reason might have been his attempt to blend notions of technological innovation with calls for social and political reform, which Ganswindt understood as invention on a societal level. In a letter to the Kaiser in 1892 he proposed the 'solution to the social problem,' which included a few socialist ideas, but was a mix of more or less naive notions.[66]

However, the Ganswindt case was not that singular after all. While he might have been the only engineer to propagate ideas of spaceflight, he was not the only person in Berlin who publicly endorsed ideas and concepts that were on the edge of accepted science. Considering also his notions about alien life, Ganswindt engaged in pseudo-scientific as well as spiritualist discussions that took place not only in literature, but from the 1890s also extended to lectures and shows. The 1902/03 case of the medium Anna Rothe, analyzed in great detail by Corinna Treitel, was probably the most prominent example of how harshly Berlin authorities acted against individuals who were perceived to be esoteric frauds.[67] Being very popular with her shows in which she conducted séances and materialized objects 'out of thin air,' Rothe was arrested during a performance, detained and sentenced to eighteen months of jail after a major trial that aroused international attention and that was considered by some contemporaries to not only be about Rothe but about the course of civilization and liberalism as a whole.[68] Treitel has aptly observed how spiritualism and esoteric celebrities such as Rothe endangered the fragile structure of knowledge authority in Berlin through distorting the relationship between academic elites, state institutions and the church as knowledge producers, and the public as consumers. Spiritualistic belief also uncovered tensions between public education and the liberalization of the German society, both being accepted as driving forces of civilization yet producing contradictions at the same time.[69]

Disenchantment was not a practice directed against traditional belief. Rather, the irrational existed as counterpart to the rational and was itself a modern phenomenon. Alternative forms of knowledge production became immensely popular when the popularization of science through public performances was institutionalized. The case of Hermann Ganswindt shows that sensationalism was an equally important component of what sometimes became considered a fraud in *fin-de-siécle* Berlin. Professional outsiders successfully used the very same forms of knowledge popularization and, therefore, the same market as traditional elites, sometimes making a lot of money with it. The state's restrictions, however, were limited to individual cases and did not extend to major bans of esoteric or alternative scientific teaching.[70] Disenchantment, it can be argued, was no cultural force that somehow 'disenchanted' society, but was rather an argument and rhetorical practice performed by actors in specific contexts. As any argument it was therefore part of debates and propelled discussions about the possibilities of knowledge, rather than hindering them.

In the early 1900s, Ganswindt described himself as a genius who was naturally unlucky and unfairly treated by fate.[71] This self-representation as an unrecognized visionary was only later taken up by the Weimar spaceflight enthusiasts. As an old man in the 1920s, Ganswindt became a historical figure of reference for the young space enthusiasts.[72] The idea that their work would later be accepted as ingenious reflected their societal status and aspirations in the late Weimar years. While their imaginative constructions of the future became popular, their institutional and political impact remained unclear. They recognized Ganswindt as a somewhat curious predecessor, but a visionary nevertheless.

Spaceflight in fiction

Mass-produced technology fiction in the 1900s uncoupled notions of technology and socio-cultural utopias in outer space by highlighting the engineering aspect. Although this often distinct focus on technology explicitly emphasized its compliance with scientific reasoning, scientists reacted skeptically and instead gradually made their peace with notions of utopia in space and extraterrestrial life put forward by sophisticated works of fiction, particularly Kurd Lasswitz's (1848–1910) novel *Auf zwei Planeten* [On Two Planets] of 1897.

The hint at social and political utopias being one of its central features, Lasswitz's novel took up Greg Percy's plot of the superior alien. Quite different from Verne's novels or Wells's later *The First Men in the Moon*, the narrative was philosophically charged. It told the story of a peaceful invasion by Martians superior to mankind in both morality and technology. Having come to Earth by giant dirigible spaceships to civilize humans, the Martians react to the aggressive responses from European nation states by establishing a protectorate over Europe and Russia. In the end, a German private scholar is able to negotiate a peace treaty. While being a story of invasion, a genre of British origin that at the time became popular in Germany as well, it inverted the roles of imperialism. The Europeans were depicted as 'savages,' and the 'uncanny foreigners' appeared as morally and socially superior conquerors.[73] The story reflected that a limited cultural openness added to the fascination with the non-European foreigner in the late nineteenth century.[74] The novel was criticized after 1945 for being an apologia for imperialism and a display of culturally successful conquest. However, it also explicitly mocked German imperial politics and European militarism.[75]

Auf zwei Planeten presented an early form of the affinity between the dirigible and the spaceship that shaped spaceflight fantasies for decades. By using the North Pole Lasswitz connected one of the last unknown places on Earth with the potential successor of the 'frontier,' outer space. This connection of the old and the new bridged contemporary and futuristic storylines; it made the future the present, and an adventure into the unknown became an exploration of things to come.[76] However, spaceflight was not depicted as humankind's own achievement, but was instead presented as something achieved only after humans had reached a higher moral standard through their contact with aliens. Lasswitz attributed to the Martians the use of all kinds of highly developed technologies and inventions, from small gadgets such as motion detectors and solar power collectors, to large-scale technologies such as anti-gravitation engines and space stations. As Franz Rottensteiner has noted, these seemed foreseeable in Lasswitz's time.[77] According to Darko Suvin's definition, science fiction involves the 'narrative dominance or hegemony of a fictional 'novum' (novelty, innovation), validated by cognitive logic.'[78] The possibility to deduce that innovation from the status quo in science and engineering became a central feature of technology fiction.

What made this deduction possible and how did future innovation come to seem plausible? While notions of utopia decreased in technology fiction, future outlooks became increasingly rooted in the present. Tzvetan Todorov and Gerard Genette have both highlighted the importance of social discourse for the credibility of literary accounts in the early modern French novel. A depiction seemed plausible when it was based on commonplaces and opinion about social realities.[79] When we discuss modern technology and ask about historical correlations, explanations become more complex. While the plausibility of a future vision was established within narratives, notions of a foreseeable feasibility of a specific technology more heavily depended upon contextual factors, such as the nexus of popular literature and science and the author's social and professional authority. The plausibility of technology visions was therefore based on connections of innovation and tradition in technical, cultural, and social aspects.

Lasswitz was not only a popular writer, but also a mathematician, philosopher, and school teacher in the city of Gotha, who had aimed at becoming a university professor. Lasswitz never reached that goal, probably because of having written too many popular stories.[80] He emphasized Humboldt's *Kosmos* ideal to educate all social classes through science, published numerous articles on science and philosophy between 1890 and 1910 and co-founded the *Mittwochsgesellschaft zu Gotha* that organized popular presentations on intellectual subjects. His *Auf zwei Planeten*, written after he had already abandoned most of his academic goals, became a modestly growing success with many reprints and inspired other writers to devote stories and novels to the idea of spaceflight.[81] Among them was Hans Dominik (1872–1945), his former student at Gymnasium Gotha. An electrical engineer by training, Dominik was hired by newspapers and popular science periodicals to eventually become a full-time science and technology journalist.[82] A change into the journalist profession became a possibility for engineers in a time when editors were looking for competent staff to cover developments in science and technology. Also delivering fictional short stories, the young writers' science fiction even more highlighted an allegedly scientific approach, tried to predict the future accurately and to even blend their stories with non-fictional accounts.

While the turn of the century was dominated more by political than technological predictions in the German press, in the early 1900s space fiction became popular mass literature, following similar developments in Britain and France.[83] Carl Grunert (1865–1918), a Berlin school teacher, based his novels *Feinde im Weltall?* [Enemies in Space?] in 1907 and *Der Marsspion* [The Martian Spy] in 1908 on Lasswitz's concept of Martians contacting and infiltrating Earth, while already detracting the socio-critical component. Oskar Hoffmann's (1866–1928) *Mac Milfords Reisen im Universum* [Mac Milford's Travels through the Universe] in 1902 shifted the focus from contact to the flight to the Moon and depicted the pioneer as a 'mad scientist' ahead of his time and misunderstood by his contemporaries.[84]

For Britain, James Secord has identified the decreasing costs of paper and printing machines as important factors in the increase of the reading public, while Alleen Fyve and Bernard Lightman have highlighted the role of publishers in expanding the popular media markets at the end of the nineteenth century.[85] Also in Germany, it was not the work of a few independent pioneers who established new plots of space travel in the adventure genre, but the appearance of new mass media can be identified as a central turning point in regard to the spaceflight narrative. The publication of space fiction in technology magazines facilitated notions of technological feasibility on a formal level. A habitual combination of popular science, technology, fiction, and visual images introduced the concept of the spaceship and conveyed notions of plausible progress. The over-

all focus on technology closed the gap between popular science and fiction on the level of writing when the same group of journalists and engineers provided both fiction and non-fiction. While technology came even further to the fore compared to Lasswitz, and Jules Verne's works became the more important point of reference, the political and philosophical comment became rather allusive or ambiguous.

From 1907 to 1918 Hans Dominik wrote eight articles for the yearbook *Das neue Universum* [The New Universe], among which there were four short stories that involved space travel or extraterrestrials. Another short story portrayed the world in 1970 as dominated by aviation, especially gigantic Zeppelins. The story coincided with a non-fictional article on the airship in the same issue by the later director of Zeppelin Hugo Eckener. Fantasy and fact complemented each other: where the non-fictional account on the present state ended, Dominik's description of the future took over.[86] *Das neue Universum* marked a new genre in two regards: first, unlike the older popular science accounts it relied heavily on visualizations, especially detailed sketches and cross-sections, giving the reader the opportunity to imagine himself in the locomotive or airship shown;[87] and second, it emphasized the look into the future with optimism and belief in technological feasibility. The books did not only present scientific knowledge. Optimism was often connected to the idea of rapid progress, and the engineer appeared as the leader who guided the society into an advanced (but more familiar than utopian) future. In the 1900s, the periodical began to include fiction sections, and while the technological focus of its articles changed from trains and industrial machines to airships and planes, the short stories increasingly dealt with spaceflight and other more futuristic outlooks.

In Dominik's short story *Die Reise zum Mars* (1908) humans went to Mars by antigravitation device in the year 2109, while in *Ein Experiment* (1913) a German engineer established contact with Martians via electrical waves and did not go into space. While the discovery of remote extraterrestrials became a problem of technology, aliens no longer necessarily appeared as fictional characters. The later *Eine Expedition in den Weltraum* in 1918 entirely focused on the spaceflight vehicle.[88] Already in 1902, Hans Dominik published a short story about the construction of a spaceship in the *Berliner Tageblatt*.[89] Titled 'Eine Erfindung' ('An invention'), it was about a professor who invented the antigravitation motor and combined it with an airship design, effectively building a spaceship. After describing the technological details and making clear that it did not use 'rockets or the like,' actual spaceflight did not take place.[90] Accidentally the spaceship cut loose without any passengers and just floated away into space. While not overburdening the reader with an extraterrestrial plot but focusing on the marvels of technology, the story ended with an ironic outlook on things to come and profits to be made,

> … since the colonization of the mild zones of Mars will certainly be a rewarding undertaking. It would just be unfortunate if England snatched the best chunks again and established an annoying shipping monopoly on the Martian canals.[91]

The new paradigm in Dominik's spaceflight narrative has to be understood as a reaction to the popular enthusiasm concerning the machine vehicle and the airship in particular. When in 1907 and 1908 the Zeppelin became immensely popular in Germany, fantasies of flight were immediately extended into outer space. As Guillaume de Syon has pointed out, the Zeppelin was perceived as a thoroughly modern technology. Although it was soon discerned to be inferior to the airplane, it went on to dominate German popular visions of the future.[92] Interestingly, the beginning of an enthusiasm for the airship went hand in hand with a growing objectivity, not with more fantastic tales. More and more

elements of the spaceflight narrative were highly technical and postulated a German dominance in technology. The focus shifted from extraterrestrials and invasion to human achievements and the conquest of outer space, set in a future that was within a generational reach and not inconceivably distant. The incoming perspective was turned into an outgoing perspective.

Roland Innerhofer has argued that the new technological element was just an ambivalence within the same form of science fiction.[93] However, the spaceflight narrative shifted the main attraction to presentations of human spaceflight in its technological details. While extraterrestrials were no necessary part of these stories, new technologies were also implemented in more fantastic tales. The inclusion of the airship, with short explanations of its capacity for space travel, bridged the gap from the atmosphere to space and from the present to the future. Even the alien encounter now appeared as a technological problem within human control.

The anonymously published dime novel series *Der Luftpirat und sein lenkbares Luftschiff* [The Air Pirate and his Dirigible Airship] (1908–1912) contained stories in which the protagonist Captain Mors traveled into space with his 'Weltenschiff.'[94] Detailed drawings presented a Zeppelin-shaped vehicle made of metal, while the text mentioned the anti-gravitation device as the solution to the problem of propulsion. The resemblance to the airship was stunning in its design (see Figure 3). The spaceship offered several rooms, and a drawing even gave an insight into the captain's cabin (see Figure 4). The image not only enabled the reader to visually perceive what the machine looked like from the characters' point of view, but established familiarity with the future vehicle. The spaceship was not purely futuristic: besides a control apparatus the lavish cabin also contained a bed, a bearskin, a desk, books, a globe and other artifacts of day-to-day life and research. The cabin appeared used, displaying functionality. The only human element in the image, however, was a skull, at the same time hinting not only at medical research

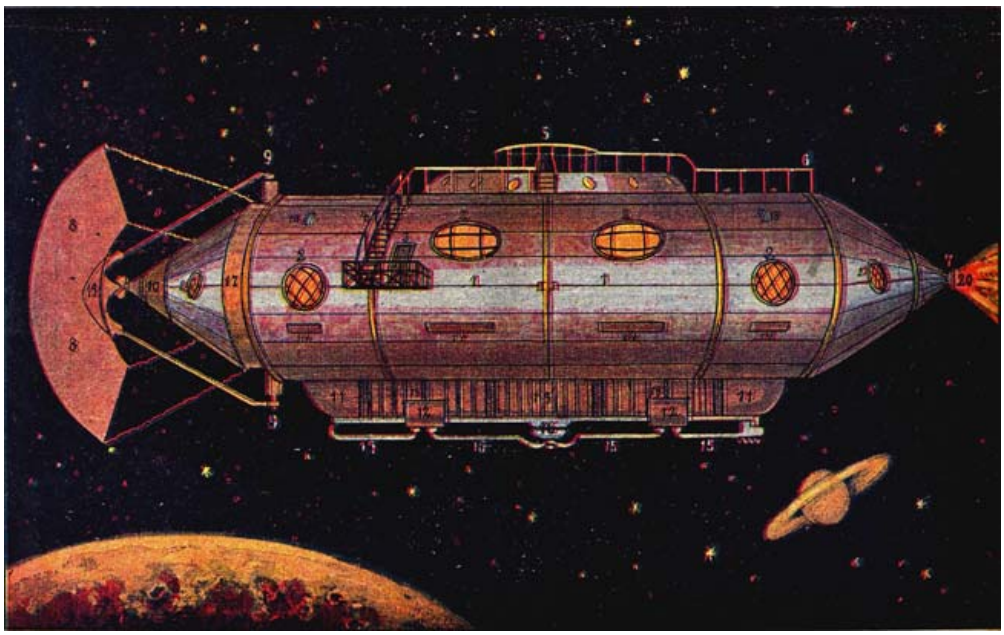

Figure 3. Illustration of the 'Weltenschiff' on the back cover of issue number 38 of the dime novel series *Der Luftpirat und sein lenkbares Luftschiff* (1908–1912). Page 32 provided detailed descriptions of the fictional apparatus and devices visible in the schematic.
Source: *Der Luftpirat und sein lenkbares Luftschiff*, no. 38: backcover.

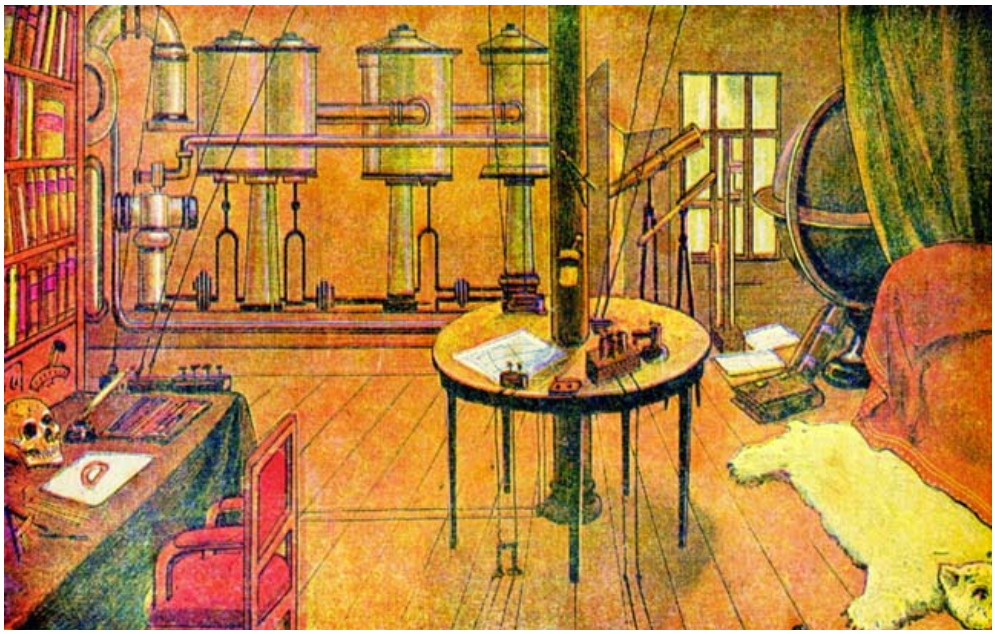

Figure 4. Drawing of Capitain Mors' cabin on the 'Weltenschiff.' Visuals in *Der Luftpirat* not only depicted machine structures from the outside, but also showed interiors and living spaces of the crew.
Source: *Der Luftpirat und sein lenkbares Luftschiff*, no. 38: 26.

and the occult, but also at death, the most obvious distinction of the human from the machine. The spaceship looked innovative, but also connected technology with familiar designs and appeared culturally and socially plausible. Passengers were not just able to live onboard, but could also read and study. With its many references to everyday domestic items and interiors, the image established the notion of a middle-class household in space.

Before World War I, the major themes and characteristics of German spaceflight technology fiction had appeared. The engineer became the central protagonist who made the future controllable by predicting it, and created new opportunities and possibilities by inventing new technologies. Second, a combination of familiar characters and fantastic innovation with pseudo-scientific proof highlighted the story's plausibility. Spaceflight fiction was based on the fascination that the visions presented were feasible. Technological details were changed, and minor flaws were tolerated. Since it was often engineers or teachers who wrote the stories, usually aimed at a young readership, the texts still expressed authority and competence in matters of technology and science. Third, the space vehicle was a more sophisticated version of an airship in outer and inner appearance. When the illustrators later imagined rocket spaceships, they were still based on Zeppelin design. Such citations of the Zeppelin were not just references to existing technology, but alluded to what the Zeppelin stood for: national endeavor, enthusiasm, and unity.[95] Visual traditions were often stronger than narrative traditions, and in that way visualizations offered a sensual familiarity that complemented the verisimilitude of character actions, but also compensated innovative descriptions of technology in the text.

By becoming writers and consultants, engineers obtained a public voice which they used to popularize technology and predict a better future, created by technological progress and therefore by the engineers themselves. The new media fueled further demand for science fiction and popular science. Two closely related markets had established

themselves, and new economic relations had been created, with new producers and new consumers. While the product sold was entertainment, its content was the prediction of progress. This being a point of contention between old intellectual elites and new engineering elites, engineers won considerable authority over the popular interpretation of the future.

Kurd Lasswitz was worried about these developments within a genre that he had somewhat pioneered in Germany and that was about to settle in cheap magazines and dime novels. He expressed his hope that the scientific and philosophical basis of his works would keep him from being remembered as a successor of Jules Verne, and more than once saw the need to defend his approach.[96] He emphasized that people could not look at the stars without believing 'that also on inaccessible worlds there are living, feeling, thinking beings.' However, fiction should also refrain from pretending to be scientific, since both science and fiction had different advantages and aims. Science could not say anything about alien life, and fiction could not offer scientific insight.[97] This explicit dissociation of science and notions of utopia allowed scientists to not only approve of Lasswitz's novel as literature that did not challenge their own teachings, but also to accept speculation and re-associate it with science. Lasswitz emphasized that fiction had a distinct, but important goal: to shape *Weltauffassung* [understanding of the world]. Based on Immanuel Kant's critique of metaphysics, the term attempted to reconcile the sciences with philosophy, and vice versa, while not uncritically re-enchanting metaphysics.[98]

Contemporary reviews of *Auf zwei Planeten* specifically highlighted its references to Christian motifs. Wilhelm Bölsche, a philosopher and proponent of Darwinism and speculation in the sciences, applauded in 1899 that the reader felt ethical freedom when reading Lasswitz, unlike Verne, and 'that in the highest chaos of all things on Earth, when the noble is thrown into the dirt and the nonsense triumphs, something foreign, egregious, luminous will descend from the secrets of the cosmos to our dirty Earth.'[99] Bölsche linked myth and the future in his review and acclaimed the return of transcendence into space fiction.

Astronomers rather stressed Lasswitz's balanced depictions of science and the possibility of extraterrestrial life in the light of questions of philosophy and morale. Hans Lindau later recalled that the astronomer Hugo von Seliger (1849–1924) had criticized 'pseudoscientific Mars fantasies' in 1913, but explicitly excepted Lasswitz's novel.[100] Even Max Wilhelm Meyer in 1909 decided to devote a whole book on the question of life on other planets, just one year before his death. Since the airship was just a beginning in terms of aviation, he admitted, it was not impossible to imagine further advances. Since nobody could really be sure what the Martian canals were, it made no longer sense to follow the reasoning of 'strict opponents.' In reference to Lasswitz, Meyer acknowledged that speculation was possible even while being scientific and critical. Although he expressed his understanding for recent deliberations on the possibility of spaceflight, mankind had to become much more 'mature before the enormous conquest of other worlds by the spirit can succeed.'[101]

Meyer's shift of opinion signaled much more than merely an admission of speculation or re-enchantment in German scientific thought. It indicated the renunciation of the practice of disenchantment as a tool of professional distinction from other writers and a more proactive engagement with their topics. At a time when engineers predicted endless possibilities through technology, Meyer stressed the importance of moral and ethical advance. Technological progress would not bring about utopia, but utopia would enable mankind to handle technology in an ethically responsible manner. This new orientation

towards morality can best be understood in the context of what Philipp Sarasin has pointed out an erosion of the enthusiasm for both technology and the sciences within the intellectual elite since the turn-of-the-century.[102] Astronomers more actively reflected upon their own contribution and science's as well as technology's potentials and dangers. They no longer just dismissed spaceflight and alien life in order to consolidate their teachings against speculation and fantastic prophecy, but they accepted popular debates and positioned themselves within them.

While they came to accept speculation about other worlds, astronomers lost the professional conflict over the popular interpretation of feasibility and the future to engineers at the end of the first decade of the twentieth century. Mars fantasies had made outer space and alien life more and more familiar and human-like. In Sigmund Wilheim's parody short story *Besuch auf dem Mars* of 1912 a married couple travelled by airship that was unintentionally blown to the red planet. After discovering a Martian civilization, the female passenger doubted that they had actually landed on another planet, since the Martians looked and acted exactly like human beings. Her husband was rather unsurprised, 'Have you not read Wells's and Hoffmann's novels?'[103] While it was possible to outline plausible technological progress within fiction, it was difficult to imagine plausible alien characters. Depictions of technology drew upon ideas of social and cultural realities, but also had references outside the text. Even if the spaceship was new and different, it made sense in reference to past innovation. Notions of extraterrestrial characters, however, were based on social and cultural verisimilitude only – constructs that were easily identifiable as inherent to the fictional narrative and that seemed to comprise no innovative element. While extraterrestrial worlds had become a cliché, they did not maintain the prognostic attribute that characterized ideas of human spaceflight. Only technology could highlight timeframes: technology fiction was able to map out plausible future worlds since future engineering appeared as an extrapolation of the history of progress.

Innovation and disenchantment

Linear historical models of innovation cannot explain how spaceflight became accepted as a vision of the future when it was still far from the status quo of technology. The rocket was not just discovered as a potential spaceship. Before the 1920s, this particular association rather seemed implausible as a future prospect. The case of Hermann Ganswindt reminds us that at all times a pluralism of ideas and proposals was possible. These were, however, accepted and appropriated in different ways and to different extents. Actors and media produced novel contents, but they also responded to emerging subjects with appropriation and differentiation. The dynamics in this discussion about technological feasibility were shaped by the rise of popular technical magazines and science fiction mass literature, an increase in the engineers' influence on the themes discussed therein and a gain in their popular authority over forecasting the future.

While the dismissal of Jules Verne fantasies by astronomers, the only established group of experts concerning outer space in the nineteenth century, reflected a conflict between popular science and science fantasy over dispersing accurate knowledge about the universe, scientists also distinguished themselves from writers of fiction. In the 1900s, a wave of technology fiction popularly defused these contradictions within its narratives. Experts on technology such as Hans Dominik presented worlds that had advanced thanks to innovation, but the depictions were careful. They were situated in a dateable yet remote future, carrying notions of technological feasibility. This feasibility was a specific form of narrative plausibility that tied in future outlooks with the past and present.

Imagined technologies, as well as their social connotations, were based on the perceived state-of-the-art in technology and future outlooks of the *fin de siècle*. The spaceship became plausible as an artifact of the remote future when it was tied in with ideas of contemporary progress and popular mid-term prospects such as the airship. The partly innovative machine itself, the airship as the spaceship, resolved the narrative discontinuities of space travel when being blended into more traditional plots of exploration. The establishment of the technology vision of spaceflight created rules of its specific modes of imagination and communication.

Disenchantment cannot only be understood as a cultural process of the loss of traditional myth or the decrease of old belief. With disillusionment being a rhetorical tool highlighting the limits of knowledge and claiming scientific rigor, disenchantment was also part of performances displaying professional distinction for political reasons. Aiming at elevating their public relevance, astronomers did not turn against the popular imagination as such, but rather against popular myth, rash speculation in the context of science and uncritical belief in the wonders of engineering. Their opinion concerning speculation about alien life changed in the 1900s and notions of utopian otherworlds became more common, when at the same time cheap fiction rather shifted the focus to the technological appropriation of outer space.

The forms of disenchantment analyzed here argued for the differentiation of science and transcendence, the internalization of transcendental experience versus external, dispassionate observation. That was not meant to generally eliminate transcendence, but rather to legitimate it, complementing transcendence and science as different spheres of the production of meaning and knowledge about the infinite cosmos. Therefore, modern astroculture can be understood as being shaped by attempts to overcome scientific positivism through what Wilhelm Dilthey outlined as its solution: the differentiation of the German academic disciplines into humanities and the sciences.[104] From this beginning, astroculture developed as a quintessentially interdisciplinary product.

Within their ambivalences science, technology, and societal prospects were compatible and offered diverse interpretations. The concept of utopia, however, lost much of its alterity. Outer space seemed accessible, while alien life and space became more human and familiar. The sky turned into a merely spatial transition, while the transition from the human to the transcendent moved out into the remote vastness, at the same time a rather internalized and intellectual realm. The emergence of technology fiction marked the establishment of astrofuturism as a specific feature of astroculture: Technology improved society, while fundamental norms and values were not touched. The disenchantment of the cosmos indirectly de-problematized innovation. The absence of fantastic utopias provided the potential for real, reachable, somewhat immediate and in any case controllable betterments. It was not fantasy that invented futurism, but it was rather ever-new practices of disillusionment of fantasy that delineated futuristic notions of possibility.

Spaceflight was imagined as a technoscientific project, which introduced technoscience, also an ideal amalgamation of science and technology, as a feature of astroculture long before spaceflight became a practical reality. This did not only mean that fiction covered both scientific and technological aspects in its stories, but also that both kinds of knowledge became necessary components of imagined future projects. Different accounts, particularly popular science and technology fiction, created compatible knowledge even when their authors disagreed. While the disciplines differentiated, popular discussions increasingly looked for compatibility.

It took another two decades before spaceflight societies formed in the late 1920s and considered and successfully promoted rocket technology. The generation of the rocket

pioneers, born around 1900 or 1910 and studying at German technical universities in the Weimar Republic while engaging in rocket societies, often expressed retrospectively that they had been inspired by popular space fiction during their youth and childhood, most prominently Wernher von Braun and Hermann Oberth.[105] The Weimar enthusiasts were able to draw upon notions of spaceflight from popular fiction, favoring the rocket while illustrating it as a successor to the airship, even writing their own fiction in the traditions of Lasswitz and Dominik. At the same time, however, they again established new ways of communicating their ideas in newspapers, academic circles and at public events, introducing novelties on thematic and formal levels alike. Early German spaceflight thought before World War I was not a linear predecessor of the later rocket enthusiasm, but an earlier and prominent phase in the same history, opening up narratives and potentials.

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Notes

1. Ganswindt, 'Probleme der Menschheit,' 7. It is being debated whether the Philharmonie presentation took place in 1891 or rather in 1893, with the lecture tour starting in a different German city in 1891. I am referring to the common interpretation, i.e. Essers, *Hermann Ganswindt*, 63 f. Unless otherwise noted, all translations are my own.
2. Gartmann, *Space Rockets*, 15; Verne, *Von der Erde zum Mond*; idem, *Reise um den Mond*.
3. Winter, *Prelude to the Space Age*; see also, for example, Neufeld, 'Weimar Culture and Futuristic Technology'; Neufeld, *The Rocket and the Reich*; Eisfeld, *Mondsüchtig*.
4. Oberth, *Die Rakete zu den Planetenräumen*; Ley, *Möglichkeit der Weltraumfahrt*; Brügel, *Männer der Rakete, in Selbstdarstellungen*; Philp, *Stratosphere and Rocket Flight*.
5. The term 'astroculture' has first been specified and defined by Alexander Geppert in his introduction to the collected volume *Imagining Outer Space* in 2012. Geppert, 'European Astrofuturism, Cosmic Provincialism,' 6–9.
6. Cooter and Pumfrey, 'Separate Spheres and Public Places,' 251.
7. See, for example, Latour, *Science in Action*.
8. Weber, 'Wissenschaft als Beruf,' 594.
9. It is important to note that the German term 'wissenschaftlich' had a much broader meaning than the English 'scientific,' for it referred to the humanities as well. Therefore, while also in Germany professionalization effected considerable differentiations between the two, the

German term offered a greater context of meaning. Goschler, 'Einleitung,' 20; Daston, 'Die Kultur der wissenschaftlichen Objektivität,' 11.
10. Todorov, 'An Introduction to Verisimilitude.'
11. See Dick, *Plurality of Worlds*.
12. Crowe, *Extraterrestrial Life Debate*, 206–07; Ley, *Rockets, Missiles, and Space Travel*, 31–33; Gruithuisen, *Spuren der Mondbewohner.*
13. Even when Klein particularly described the 'desire to transcend the realms of the Earth and look around, even if just in our minds,' he predicted fast progress in the sciences, but did not mention technology or address speculation about potential alien life. Klein, *Astronomische Abende*, 1; Wolf, *Handbuch der Astronomie, ihrer Geschichte und Litteratur.*
14. Schmitz, *Das Weltall*, III–V.
15. Humboldt, *Kosmos*.
16. By the eighteenth century, the first detailed maps of the Moon had ended prospects of spotting Moon civilizations, and the discovery of the thinness of the upper atmosphere eliminated the hot-air balloon as a potential spaceship. Ley, *Rockets, Missiles, and Space Travel,* 31–33, 14–18, 24–25.
17. Crowe, 'A History of the Extraterrestrial Life Debate,' 13.
18. Daum, *Wissenschaftspopularisierung*, 73–74.
19. Lockyer, *Astronomie*. Originally published as *Science Primer: Astronomy* (Appleton: New York, 1875); Huxley, *Naturwissenschaftliche Elementarbücher.* Originally published as *McMillan's science primers* (Macmillan: London, 1875); 'Grazer Tagespost: Review of *Naturwissenschaftliche Elementarbücher*'; 'Wegweiser durch die pädagogische Literatur: Review of *Naturwissenschaftliche Elementarbücher.*'
20. Jochmann, *Grundriss der Experimentalphysik*; Hermes, *Elemente der Astronomie*; Wetzel, *Allgemeine Himmelskunde*; Wetzel, *Kleines Lehrbuch der astronomischen Geographie*; Schmitz, *Das Weltall*; Georgens, *Sternbilder-Buch*.
21. Flammarion, *Die Mehrheit bewohnter Welten*. Originally published as *La Pluralité des mondes habité*s [The Plurality of Inhabited Worlds] (Paris: 1862).
22. '… die wie ein drückender Alp auf der deutschen Speculation liegt.' Pohle, 'Die Sternwelten und ihre Bewohner,' V.
23. See Schwarz, *Der Schlüssel zur modernen Welt*.
24. Verne, *Von der Erde zum Mond*. Originally published as *De la terre à la lune* [From the Earth to the Moon] (Paris: 1865); Verne, *Reise um den Mond*. Originally published as *Autour de la lune* [Around the Moon] (Paris: 1870).
25. Percy, *Jenseits des Zodiakus*. Lasswitz's *Auf zwei Planeten* and Well's *The First Men in the Moon* later employed the concept of anti-gravitation as well. Lasswitz, *Auf zwei Planeten*; Wells, *The First Men in the Moon*. Trans. as 'Die ersten Menschen im Mond' (Minden in Westf.: Bruns, 1905).
26. Ley, *Rockets, Missiles, and Space Travel*, 35–38, 42–43, 45.
27. '… wahrlich geeignet [sind], dem Aufschwunge unserer Einbildungskraft Zügel anzulegen.' Schiaparelli, 'Über die beobachteten Erscheinungen,' 93.
28. Daum, *Wissenschaftspopularisierung*, 168–83.
29. Meyer, *Von der Erde bis zum Monde*; Becker, 'Welt von Wundern,' 283, 288–89, 292–99.
30. See Meyer, 'Die Veranstaltungen der Urania,' 36.
31. 'Die angekündigte Rundreise von der Erde bis zum Monde, der allernächsten Station im Weltgebäude und dann wieder zurück zu unserem Ausgangspunkt, werden wir also nur im Geiste unternehmen können. Aber wir werden doch gar bald mit Genugthuung erkennen, dass der Geist, wenn er sich nur nicht der irrlichterirenden Phantasie überantwortet, ein völlig sicherer Führer durch diese ausserirdischen Gefilde ist, dem man sich ruhig anvertrauen kann.' Meyer, *Von der Erde bis zum Monde*, 3; see also Meyer, 'Versuch einer beweisführenden Darstellung des Weltgebäudes in elementarer Form.'
32. Bigg, 'Staging the Heavens,' 309–10.
33. Molvig, 'The Berlin Urania,' 338.
34. Bigg has shown that this double strategy for economic reasons was quite common among early astrophysicists. Bigg, 'Staging the Heavens,' 323.
35. Molvig, 'The Berlin Urania,' 341.
36. While the popularization could be privately funded, science and its standardization were outlined as a public effort. Both co-founders of the Urania Förster and Siemens had particularly

lobbied for the Physikalisch-Technische Reichsanstalt, a state institution eventually created in 1887 that was meant to coordinate and standardize gauges and measures. Molvig, 'The Berlin Urania,' 338.

37. Brodbeck, *Die Welt des Irrthums*, 14.
38. Ibid., 15.
39. Ibid., 22.
40. 'Aber selbst blosse Dichtungen, wenn sie uns durch den Himmel führen und auf Planeten, Kometen und Sonnen umherschweifen lassen, sind nicht verwerflich. Sie haben das Würdigste und Erhabenste zum Gegenstande, erheben und veredeln uns. Ihre Geltung steigt, und sie werden höchst lehrreich, wenn ihnen Wahrnehmungen und mathematische Thatsachen zu Grunde liegen; und oft sind Vermutungen durch Entdeckungen bestätigt worden, zuweilen haben sie sogar zu Entdeckungen hingeleitet.' Gressler, *Himmel und Erde*, 175.
41. Schwarz, 'Bilden, überzeugen, unterhalten,' 230–32; idem, *Der Schlüssel zur modernen Welt*.
42. Gressler, *Himmel und Erde*, 182–83.
43. 'Kein Unterricht ergreift mit solcher Kraft und so allseitig den jugendlichen Geist. Er stählt den Körper, schärft die Sinne, übt das Gedächtnis, nährt mit den edelsten Bildern die Phantasie, bildet die Denkkraft, verbannt alle Engherzigkeit, legt einen unerschütterlichen Grund zur tiefsten Gottsinnigkeit. Er giebt den allein richtigen Massstab für den Wert des Lebens, erleichtert selbst das Sterben.' Gressler, *Himmel und Erde*, V–VII.
44. 'Solche Kräfte und dergleichen Wesen wären für uns an sich unbegreiflich; man kann mit ihnen alles und deshalb nichts beweisen. Wir würden uns hierbei überhaupt nicht weiter aufgehalten haben, wenn nicht in der That von verschiedenen Seiten solche, für uns zunächst noch übersinnliche Argumente in Betracht gezogen worden wären. Das Unbegriffene aber mit dem Unbegreiflichen zu erklären heisst jedoch, sich das Spiel gar zu leicht zu machen.' Meyer, *Das Weltgebäude*, 146.
45. 'Es ist Thatsache, dass ein Buschmann, ein gar armseliges Geschöpf, das nicht im Stande ist, sich eine Hütte zu bauen, sich unter den Sternen besser auskennt als hunderttausende unserer gebildeten Grossstädter.' Meyer, *Das Weltgebäude*, 3.
46. See Jelnina, 'Tsiolkovsky's Scientific Works'; Rynin, *Interplanetary Flight and Communications*; Scherschewsky, *Die Rakete für Fahrt und Flug*; Ley, *Grundriss einer Geschichte der Rakete*.
47. See the many German book and journal titles containing 'Rakete' in mid-nineteenth century, for instance: *Raketen: Eine Zeitschrift für Freunde des Humors; Humoristische Zündnadeln*.
48. Ley, *Rockets, Missiles, and Space Travel*, 75–76; Williams and Epstein, *The Rocket Pioneers*, 3–30; Engel, 'Kurzer historischer Überblick.'
49. In 1903 the entrepreneur Alfred Maul had patented a rocket with an attached camera for aerial reconnaissance. See: 'Patentschrift 162433.' See also the patents for devices using the recoil principle by August Klumpp in Munich and Conrad Haussner in Ingolstadt and the airship concept by the Hamburg company Huettner, Walter & Co. of 1891 and 1892, respectively. 'Patentschrift 69520'; 'Patentschrift 72902.'
50. Syon, *Zeppelin*, 17.
51. Thompson, 'Hermann Ganswindt.'
52. See, for example, his advertisement in the *Berliner Theater-Welt*: Ganswindt, 'Advertisement.' Ganswindt often placed his ads in entertainment revues to call attention to his sensational concepts and inventions. Essers, *Hermann Ganswindt*, 7.
53. Advertisement in Ganswindt, *Das jüngste Gericht*.
54. 'Jawohl, es ist möglich, nicht nur in der Luft mittelst Flügel einen Stützpunkt zu gewinnen, sondern, während das Vorurtheil noch über die Lösbarkeit dieses Problems lacht, … habe ich bereits einen Stützpunkt im leeren Raum gefunden und auf Grund dieser Errungenschaft die Lösung des Problems einer Expedition nach anderen Weltenkörpern angebahnt.' Ganswindt, 'Probleme der Menschheit,' 2, 7.
55. Gartmann, *Space Rockets*, 16.
56. Ley, *Rockets, Missiles, and Space Travel*, 99.
57. 'Die Erfüllung der Lebensbedingungen in dem behaglich von aussen geheizten Coupé eines solchen Fahrzeuges ist ja schliesslich nicht schwieriger, als in einem Unterwasserboot, deren es ja schon welche giebt, und in denen der Luftvorrath in Stahlröhren komprimiert mitgenommen wird. … so z.B. hat Ganswindt … ausgerechnet, dass man, zunächst allerdings nur

theoretisch, den Planeten Mars … schon in ca. 22 Stunden wohlbehalten erreichen könnte, und, wo die Theorie physikalisch begründet werden kann, da pflegt sich auch bald die Praxis heranzumachen. Kam doch Kolumbus sogar im Mittelalter, bis Amerika, obgleich die Leute damals diesen Reiseplan für hellen Wahnsinn erklärten.' 'Moden-Zeitung: Weltenfahrzeug.'

58. Ibid.
59. Gostkowski, *Die Mechanik des Zug-Verkehres*. 'Ikarus ist nicht gestorben! Er lebt in Schöneberg nächst Berlin … Er will über die Atmosphäre unserer Erde hinausfliegen und im uferlosen Weltraum schweifen! Aber das ist ein theoretisches Hirngespinst, welches in nichts zerfliesst, sobald man es im Lichte der alltäglichen Thatsachen beschaut. … So reden wir und übersehen, dass es ein Hochmuth menschlicher Unwissenheit ist, das für unmöglich zu halten, was uns unbegreiflich erscheint.' Gostkowski, 'Ein moderner Ikarus,' 53.
60. Loos, 'Ikarus auf der Rakete.'
61. See Neufeld, 'Weimar Culture and Futuristic Technology,' and Geppert, 'Space *Personae*.'
62. Ley, *Rockets, Missiles, and Space Travel*, 92, 97–98; McClelland, *German Experience of Professionalization*, 91–94; Schwiglewski, *Erzählte Technik*, 66.
63. Meyen, 'Ganswindts Haftentlassung'; Gartmann, *Space Rockets*, 17–18; Ganswindt, *Die Wahrheit*, 16–19; 'Ganswindt gegen das Motorschiff.'
64. Ganswindt, *Die Wahrheit*, 18.
65. For freelance inventors payment by the military or the state, or selling proposals to them, were probably the most attractive and at the same time uncommon ways of making a living; the usual alternative was approaching the public and selling products directly to private investors and customers. Ganswindt had tried to attain state funding, but while the military generally rejected airship-proposals in the 1890s, he did not succeed in creating a contract with the Berlin fire department, which was interested in his horseless carriage in 1894. Ley, *Rockets, Missiles, and Space Travel*, 95–97; Gartmann, *Space Rockets*, 18; Syon, *Zeppelin*, 16–18.
66. Ganswindt, 'Die Lösung des sozialen Problems.'
67. Treitel, 'The Culture of Knowledge.'
68. Ibid., 127–30.
69. Ibid., 153.
70. Ibid.
71. In 1904, Ganswindt presented his family to the public in a New Year's greeting, titled 'Happy new year wishes the most disdained family under the sun.' The greeting was intended to prove his educated middle-class affiliation by explaining that all his children were among the best in their respective school classes, and his four-year-old son Sigurd was already interested in technology, but still, he explained, his whole family had to suffer. Ganswindt, *Die Wahrheit*, 19.
72. Already in 1920 the *Allgemeiner Humanistischer Kulturbund* invited Ganswindt to hold a presentation and was quite impressed. While an embittered Ganswindt speculated that Zeppelin and even the Wright brothers had just copied his early concepts, the conservative society applauded his arguments against Albert Einstein's theory of relativity. Dost, 'Bericht über den Vortrag von Hermann Ganswindt im Allgemeinen Humanistischen Kulturbund'; Kaiser, *Kleine Raketenkunde*.
73. Rottensteiner, 'Kurd Lasswitz,' 292. Interesting to note, but probably without any connection to Lasswitz, H.G. Wells published his Martian invasion story, *War of the Worlds*, only one year later, in 1898. See also Clarke, *Voices Prophesying War.*
74. Heinritz, *Andre fremde Welten*, 28–31.
75. Rottensteiner, 'Kurd Lasswitz,' 289. See particularly Lasswitz, *Auf zwei Planeten*, 573.
76. An airship trip into arctic regions became a recurring theme in science fiction. It later even appeared in the American movie series *Buck Rogers, 1939.* Later the so-called 'Area 51' became a popular place in American science fiction, again bridging the frontiers of the past and the future.
77. Rottensteiner, 'Kurd Lasswitz,' 292.
78. Suvin, *Positions and Presuppositions in Science Fiction*, 66.
79. Todorov, 'An Introduction to Verisimilitude'; Genette, 'Vraisemblance.'
80. Although established university elites engaged in popular science as well, writing for the masses was usually not regarded a worthwhile activity for aspiring scholars. Even the Viennese geologist Eduard Reyer, promoter of the public library system, advised young research-

ers to not engage too much in teaching the public because it could be read as a deliberate waste of working time and could make it difficult to attain tenure. Reyer, *Handbuch des Volksbildungswesens*, 101; Daum, *Wissenschaftspopularisierung*, 423–25; see on Lasswitz: Lindau, *Empfundenes und Erkanntes*, 19–21.

81. Rottensteiner, 'Kurd Lasswitz,' 289; Fischer, *The Empire Strikes Out*, 58–61.
82. Shortly after starting at Siemens in 1898, Dominik moved to the publicity department and also wrote his first articles on technology for Rudolf Mosse's liberal *Berliner Tageblatt*. In 1905, he got a full-time job as a reporter for technology-related issues at the *Berliner Lokal-Anzeiger* which belonged to the nationalist newspaper empire of August Scherl. The political context of Dominik's work changed, while his articles on technology remained politically ambiguous before the First World War. After the war, however, his technological fiction became much more nationalistic. Eventually, Dominik would become one of the most successful authors of rightist science fiction of the Weimar Republic. See: Fisher, *Fantasy and Politics*, 104–15.
83. See Zweckbronner, *Mythos Jahrhundertwende*; Neitzel, *Zukunftsvisionen der Großmächte*; Innerhofer, *Deutsche Science Fiction*, 233–36.
84. Grunert, 'Feinde im Weltall?'; Grunert, 'Der Marsspion'; Ritter, *Anno Utopia*, 248; Hoffmann, *Mac Milfords Reisen im Universum*.
85. Secord, 'Scientific Conversation'; Fyfe and Lightman, 'Science in the Marketplace,' 4–6.
86. Dominik, 'Eine Reise ins Jahr 1970'; Eckener, 'Herstellung moderner Luftfahrzeuge.'
87. From 1891 on, the yearbook contained at least one large fold-out profile of a large machine and an appendix with tips for handicraft work. On visual representations of spaceships and outer space also see William Macauley's article in this issue.
88. Dominik, 'Die Reise zum Mars'; Dominik, 'Ein Experiment'; Dominik, 'Eine Expedition in den Weltraum.'
89. Dominik, 'Eine Erfindung.' Originally published in *Berliner Tageblatt* (1902) and in Dominik, *Technische Märchen*.
90. Dominik, 'Eine Erfindung,' 12.
91. '… denn die Kolonisation in den gemäßigten Zonen des Mars ist sicherlich eine lohnende Sache. Bedauerlich wäre es nur, wenn auch dort wieder England die besten Brocken vorweg schnappte und auf den Marskanälen ein unleidliches Schiffahrtsmonopol etablierte.' Dominik, 'Eine Erfindung,' 14.
92. Syon, *Zeppelin*, 132–33.
93. Innerhofer, *Deutsche Science Fiction*, 360.
94. *Der Luftpirat und sein lenkbares Luftschiff*. See especially No. 32, 38 and 42.
95. See on the Zeppelin fad: Syon, *Zeppelin*, 16–18, 54–55, and Fritzsche, *A Nation of Fliers*, 22–27.
96. Lasswitz, 'Commentary on Jules Verne.'
97. Lasswitz, 'Unser Recht auf Bewohner anderer Welten.'
98. Lasswitz, 'Über Zukunftsträume.' The term 'Weltauffassung' became central in 1920s discussions about logical positivism, particularly within the 'Vienna Circle' of Moritz Schlick and others. See, e.g. Verein Ernst Mach, *Wissenschaftliche Weltauffassung*.
99. 'Und man fühlt in allem Phantasienebel etwas, was Verne niemals hat. Es weht den Leser ein Hauch des Grandiosen, ethisch Befreiten von diesen Menschen 'auf zwei Planeten' an – wirklich etwas von jener tiefen Ahnung, die seit Jahrtausenden durch die Völker geht: dass im höchsten Chaos aller Erdendinge, wenn das Edle in den Kot getreten liegt und der Unsinn triumphiert, dass dann aus dem Geheimnis des Kosmos heraus ein Fremdes, Ungeheuerliches, Strahlendes auf diesen schmutzigen Planeten niedersteigen werde.' Bölsche, 'Das Märchen vom Mars (1899).'
100. Lindau, *Empfundenes und Erkanntes*, 33; Rottensteiner, 'Kurd Lasswitz,' 289.
101. Meyer, B*ewohnte Welten*, 4–5, 82–83.
102. Sarasin, 'Das obszöne Genießen der Wissenschaft,' 213–14.
103. Wilheim, 'Besuch auf dem Mars,' 284; Innerhofer, *Deutsche Science Fiction*, 283.
104. Dilthey, *Einführung in die Geisteswissenschaften*, 4–21. [Originally published in 1883.]
105. Esselborn, *Utopie*, 121. Oberth, 'My Contributions to Astronautics,' 129–31.

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