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Research article

The Weightlessness of Flying: Toward a Phenomenological Theory of Tragedies in Technology

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Abstract
Tragedy can be understood as a pre-modern narrative form used to make sense of real-world experiences. Tragic experience has long been part of humanity's engagement with technology. However, recent developments such as digitalization, the rise of AI, and advances in biotechnology significantly increase the potential for harmful unintended consequences. In this paper, we (1) distinguish categorically between first-order and second-order tragedy in relation to technology. With the first category, we refer to a direct reversal of the technological consequences, which turns against the value originally associated with the use of the technology. With the second category, we refer to gradual changes in quality of life that cannot be captured "objectively" but can only be attested from a first-person perspective. We focus on second-order tragedy, as it is closely connected to language, narrative forms, and hermeneutic interpretation. To deepen our understanding, we (2) provide a phenomenological reading of allegories of human flight in literature and the arts, examining them as examples that illuminate both first- and second-order tragedy. Drawing on myths, fairy tales, plays, and novels such as "Daedalus and Icarus", "The Snow Queen", "Christmas Eve", "The Satanic Mill" and "Homo Faber", we show that experiences of weightlessness, exhilaration, and rapid ascent frequently appear as narrative motifs that precede and foreshadow later tragic technological consequences.

Keywords: Ambivalence of technology; Hermeneutics; Gradual disruption; Dialectics; Digital transformation; Human flight

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Научная статья

Невесомость полета: К феноменологической теории трагедии в технике

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Аннотация
Трагедию можно понимать как досовременную повествовательную форму, используемую для осмысления реального мира. Трагический опыт давно является частью взаимодействия человечества с технологиями. Однако недавние разработки, такие как цифровизация, развитие искусственного интеллекта, и достижения в биотехнологиях, значительно увеличивают потенциал для вредных непредвиденных последствий. В этой статье мы (1) категорически различаем трагедию первого порядка и трагедию второго порядка в отношении технологий. Под первой категорией мы подразумеваем прямое обратное действие технологических последствий, которое обращает вспять ценность, первоначально связанную с использованием технологии. Ко второй категории мы относим постепенные изменения в качестве жизни, которые невозможно зафиксировать “объективно”, а можно только наблюдать от первого лица. Мы фокусируемся на трагедии второго порядка, поскольку она тесно связана с языком, формами повествования и герменевтической интерпретацией. Для углубления нашего понимания мы (2) предлагаем феноменологическое прочтение аллегорий человеческого полета в литературе и искусстве, рассматривая их как примеры, которые освещают трагедии как первого, так и второго порядка. Опираясь на мифы, сказки, пьесы и романы, такие как “Дедал и Икар”, “Снежная королева”, “Ночь перед Рождеством”, “Крабат, или Легенды старой мельницы” и “Хомо Фабер”, мы показываем, что переживания невесомости, восторга и стремительного подъема часто выступают в качестве нарративных мотивов, предшествующих и предвещающих последующие трагические технологические последствия.

Ключевые слова: Амбивалентность технологий; Герменевтика; Постепенное разрушение; Диалектика; Цифровая трансформация; Полет человека

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INTRODUCTION: "TRAGEDY" IN HUMAN LIFE AND IN A TECHNOLOGICAL SOCIETY

Debates about technologies such as artificial intelligence (AI), unmanned drones, genetic editing, and climate engineering are shaping perceptions of technology in the third decade of the 21st century. It is striking that their social perception is often expressed in linguistic patterns of ambivalence and, repeatedly, of tragedy. Earlier technological upheavals, such as the invention of the railroad, the radio, or the robot, were accompanied by a discourse that oscillated between promises of salvation and disillusionment. In this context, the term "tragic" refers to a culturally deeply-rooted pattern of interpretation that linguistically frames experiences of failure, the reversal of expectations, and the inevitability of adverse developments (Trautsch, 2020b; 2023).

Technological consequences can not only contradict the intended goal, but also reverse it – even to the point of existential and deadly consequences (Barbour, 1983). Tragic technological consequences are a subset of unintended technological consequences (Grunwald, 2019) with existentially negative effects.

This article examines the connection between technology and tragedy as a discursive figure in the context of technology ethics, technology assessment, and anthropology of the human-environment relationship. The focus is on the question of under what conditions it appears linguistically and conceptually justified to speak of "tragic" technological consequences and what this means. Discursively, two forms can be distinguished: First-order and second-order tragedy. While another publication (Grossarth & Grunwald, 2026) focused on tragic technological constellations of the first order, this article focuses on more detailed definitions of second-order tragedy.

The "first-order tragedy" refers to immediate reversals of intended effects of technology, e.g., when technologies designed to combat hunger actually exacerbate it. A current example is the use of air conditioning systems. In order to keep houses, offices, and entire cities habitable in the face of accelerated climate change, air conditioning systems are being installed at a rapid pace worldwide. However, their energy consumption further accelerates climate change – at least as long as a large proportion of the energy required is obtained from fossil fuels, currently more than 80 percent worldwide. Air conditioning systems currently account for about 7 percent of global electricity consumption and around 3–4 percent of greenhouse gas emissions – and the trend is rising (Ritchie, 2024). In this way, air conditioning systems are exacerbating the very problem they are supposed to solve.

The "second-order tragedy" refers to creeping, qualitative changes in social conditions, such as a reduction in human scope for action to the point of losing the freedom to shape one's own life (cf. next section). These qualitative changes affect, for example, the role of the individual in decision-making processes dominated by technical experts in business, science, or government. For example, sensory or atmospheric impressions may lose their legitimacy. This category cannot be grasped "objectively" from an outside perspective, but rather reveals itself in experience reports, and personal and literary testimonies as interpretations of such experiences. A striking example is the smartphone: It offers the freedom to shop anytime, anywhere, but can also remove the

spatial and temporal boundaries of "shopping addiction," thereby significantly reducing the quality of life of susceptible individuals. The latter would be a tragedy of the second order. Here, a distinction must be made analytically between the external attribution of a pathology, which should always be viewed critically in terms of power, and the first-person experience of this phenomenon.

While tragedy is generally a cross-epochal human experience, each era produces its own forms of tragedy and ways of addressing it. Candidates for tragic downfalls currently include information technology revolutions such as automated writing and intelligent image and text generation by AI in the form of DeepSeek or ChatGPT. They are changing the division of labor between humans and machines and are much more than mere tools, as their use influences people and leads to changes in their perception and behavior. There is widespread concern – and this marks the tragic fall height of these technical developments – that they not only devalue learned skills and render acquired social and cultural capital obsolete, but also automate combinatorial, comparative, and analytical thinking. This would touch on central anthropological questions of freedom, sovereignty, and autonomy, far beyond the established topics of data protection, control, and the definition of intellectual property (cf. next section).

Other areas of possible tragic falls can be found in the field of human enhancement through AI-based medicine, biotechnological processes, or the utopian "flight project" of colonizing Mars. Elon Musk's plans to colonize Mars with a million people (Fig. 1a), which are steeped in salvation history, appear to be doomed to spectacular failure. Musk argues that a "multi-planetary species" would be more crisis-resistant, but he also speaks hedonistically: "It would be quite fun to be on Mars [...] We just need to change the populations because currently we have seven billion people on Earth and none on Mars" (Musk, 2017, p. 46).

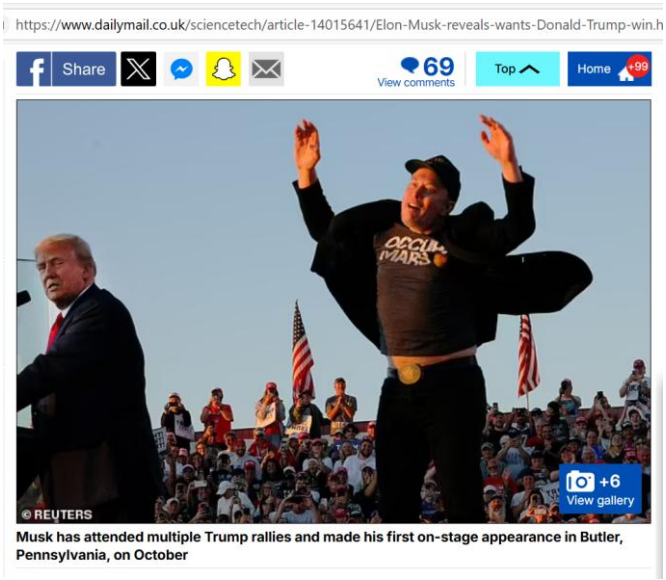

Figure 1a. Before departure to a better life on Mars? Musk wearing an "Occupy Mars" shirt during the American election campaign (Image Citation from Daily Mail)

At present, we can therefore observe a renaissance and radicalization of salvation-historical expectations (e.g., Grunwald, 2021), but at the same time, we see gloomy diagnoses of multiple crises, some of which relate to the same technological visions. The line between expectations of paradise and apocalyptic fears seems to have become so narrow that it appears almost impossible to navigate it in an epistemologically valid manner. With the inflationary expansion of expectations of salvation into the immeasurable, the potential fall into existentially tragic developments grows, even to the point of the repeatedly discussed end of humanity, for a variety of reasons.

Against the backdrop of this contemporary diagnosis, this article is dedicated to the analytical clarification of second-order tragic developments in the context of current technology debates. To this end, we will first develop the analytical tools and refine our theses on second-order tragedy in the digital transformation (next section), before turning our attention to the subject area of tragedy perceptions in literary narratives of flying (subsequent section), and discussing the results of our work with regard to their relevance to the discourse (final section).

TRAGEDY OF THE SECOND ORDER: GRADUAL DISRUPTIONS IN THE DIGITAL TRANSFORMATION

We see the phenomenon of negatively experienced qualitative changes in living conditions as a second-order tragic effect. These cannot be "read" from history as clearly and objectively/quantifiably as the first-order consequences.

Characterization of Second-Order Tragedy as Gradual Disruption

Second-order tragic effects are not immediately obvious. They manifest themselves in the ambivalence of technology use, particularly in the devaluation of sensory impressions and traditions that shape human life. This ambivalence can affect various areas: Individual lifestyles, the socio-political context, or economic power structures (cf. Schelsky 1965).

For this reason, they are also the subject of conflicts of interpretation and are rarely consensual. They can be attested to, lamented, and described by people. These effects concern factors such as changes in language habits or scope for action, accepted lifestyles, working methods, the social legitimacy of leisure time or forms of expression, or other qualitatively measurable factors. Their existence, gravitas, or technology-related causality is not as clear-cut as in the case of first-order technological consequences. To quote Hans Blumenberg, one could say that metaphors are needed to describe them – such as a loss of "depth", "brightness", or "breadth" (Blumenberg 1971). This is not about individual values, but rather more complex and diverse ideas about the good life and the possible threats to it.

Second-order tragedy cannot therefore be satisfactorily defined, but it can certainly be captured narratively. Narratives require a narrator's perspective. The perception of tragedy can be sharpened and reflected linguistically through literary, historical, or biographical analogies. In other words, this requires a cultivated sense of tragedy, a "trained eye". In this context, one can speak of an epistemic function of physical-personal

feeling. Using a term from psychology, this could be described as "intermodal perception" (Lewkowicz, 1999). Second-order tragedy can be linked in a specific way to the concept of disruption. This term is used to describe the breakdown of stable social conditions. In mass media communication, catastrophic narratives often come into play, such as the takeover by an AI algorithm, the fear of nuclear war, climate change as the end of the Earth's habitability, the end of democracy, or the collapse of the labor market due to massive automation. Expectations of stability, assumptions of continuity, and planning certainties are shattered, making the future appear uncertain.

However, second-order tragedy does not manifest itself as sudden disruption, such as the rapid spread of the Covid-19 virus or new military conflicts, but as gradual or incremental disruption. Yet, this constellation of words seems conceptually absurd or paradoxical. Of course, it should be remembered that even when they occur suddenly, discontinuations and breakdowns can build up slowly over long periods. For a long time, everything remains stable, no one suspects the coming disruption, and it is only later and unexpectedly that the sudden and frightening effect occurs.

Examples of this type of disruption are known from the technical world, especially material fatigue and wear. The daily stress on many technical objects, such as bridges or components in automobiles, gradually leads to the degradation of materials and components. Nevertheless, they continue to function reliably for a long time until the wear-and-tear reaches a point where something fails from one moment to the next, such as a V-belt in a car that suddenly breaks, or a bridge collapsing without warning as a result of corrosion damage, as happened in Dresden in 2024, or near Savona, Italy, in 2019. In hindsight, people often ask whether one could have known beforehand.

The disruptive effect in processes of this kind is inherent in incremental processes that are difficult to recognize. It can remain undetected for a long time and escape early intervention or preventive measures, such as renovation in the case of the bridge. However, when the disruption suddenly occurs, it can have far-reaching consequences. From the perspective of the dialectic of enlightenment (cf. Adorno & Horkheimer, 1947/1997), this can be described as a gradual, initially barely noticeable reversal, similar to the shift in roles in the dialectic of master and servant. This is precisely the mode of second-order tragedy.

Second-Order Tragedy as a Possible Gradual Disruption in Digitalization

The term gradual disruption can be used analytically to address possible developments in digital transformation with the potential for second-order tragedy. Fears of gradual disruption can be found at various levels in the debates on digitalization. The following should be mentioned: Stories about the end of freedom, the loss of individuality, the loss of the future, the loss of human encounter, and the reduction of human life to measurable data. It should be emphasized that these stories do not represent predictions of future developments, but rather address current contested concerns, or those which are dismissed as irrelevant and are therefore only accessible hermeneutically.

Loss of Freedom and Individuality

If flying is an allegory for freedom (next section), then tragedy of the second order means loss of freedom. Promises of security through accident prevention or counterterrorism repeatedly provide arguments for infringing on civil liberties through surveillance and control. Regulation, the legal system, and security agencies are supposed to ensure that people do not exercise their freedoms at the expense of others. Technical surveillance and control systems are used to promote security or enforce it completely. Digitalization provides powerful tools in this regard. Comprehensive surveillance by cameras, automated facial recognition, location tracking and movement profiling, pattern recognition in offender profiles, technical specifications in operation, and even the removal of the "human factor" from technical processes such as autonomous driving offer far-reaching possibilities for technical prevention of the misuse or abuse of human freedoms – but also for abolishing freedoms. Gradual disruption in this field would be an unnoticed slide into a world in which the security interests of individuals and the state become the supreme purpose and value and are no longer weighed against other values. This would lead to ever-increasing digital standardization of human behavior, and thus to the demise of individual freedom and the erosion of the democracy based upon it, in favor of systems that are controlled by digital means and are secure but unfree. Typical of a second-order tragedy here is that the excessive emphasis and enforcement of an undoubtedly desirable value – security, i.e., "freedom from interference" – can imperceptibly and insidiously render the equally desirable value of positive freedom obsolete. If the omnipresence of surveillance cameras in a city center area, for example, led to unsuspicious people increasingly avoiding them over time because they "feel monitored", that would be a tragic second-order technological consequence. If a dictatorial government were to use them to suppress freedoms (of speech, assembly, demonstration), it would be a tragic first-order technological consequence.

Digital networking has become an integral part of life, without which many people feel incomplete, disconnected, and empty. Silence and loneliness – culturally-historically often seen as quite positive states – are then perceived as difficult to bear. Individuals enjoy the potential for individualization offered by digital transformation and increasingly tailor their network environment to their needs, thus appearing to become more and more "individual". However, this harbors the potential for second-order tragedy. According to Georg Simmel (1890), individuality arises from the intersection of social circles and continues to develop in this way. It is true that the internet greatly increases the possibilities of intersections with the "circles" of others and thus indeed creates new opportunities for further individualization. However, if the circles and the connections created by these intersections were calculated digitally based solely on past profile data, there would be no new intersections. Instead, only those circles that match the existing intersections would intersect. Looking at the internet, for example via a search engine or by querying ChatGPT, would then yield nothing new, but rather reproduce one's own data from the past. The other, the potentially surprising and irritating, the foreign and the new, which according to Simmel further develops individuality, would be digitally filtered out. Even in the digital global network, one would only meet those one always meets anyway. This would be a world in which meaningful further individualization

through friction "with the other" (cf. Levinas, 1963/1986) would no longer be possible. Individuality would become solipsism in the filter bubble (Ross Arguedas et al., 2022). This narrative of the end of individuality can be addressed as a gradual disruption: The dignity of the individual and the value of individuality, prerequisites for a vibrant democracy, could gently disappear in this way, while keeping people under the illusion that they are still individuals.

Loss of the Future

Digital technologies operate based on past data. This means that digital twins only ever represent yesterday's world, e.g., by creating customer profiles based exclusively on past consumption patterns. The same applies to forecasts that extrapolate patterns based on statistical premises. Big data technologies can only evaluate past data and recognize past patterns. AI systems can only be trained using data from the past. Data from the future is not available. Forecasts created with the help of AI and big data are based on pattern recognition in past data. When these correlations and patterns are used to make predictions about the future, past conditions are carried over into the future, are imposed on it, so to speak. The future as an at least partially open space of alternative paths and possibilities is replaced by a data-based extension of the past. For many areas of application, this is likely to be unproblematic, as it corresponds to learning from the past for the future. However, learning from the past is often motivated by something quite different than the desire to extend it into the future. On the contrary, it could also be intended to ensure that certain past conditions, such as previous discrimination, are not continued in the future, but rather changed. This distinction would be lost if digital evaluation and decision-making processes were uncritically entrusted with the future.

In light of multiple anthropological definitions of humans as beings with a future and the ability to visualize and reflect on possible futures (e.g., Kamlah, 1973), not only as an extension of the past but also as a new creation in a space of many possibilities, a gradual disruption may occur: The replacement of openness and the malleability of the future, or of thinking in alternatives in favor of a data-driven orientation toward the past. What would be tragic here is the imperceptible shift from the belief that digital technologies open up the future to a world that is increasingly digitally driven and oriented toward the past.

Loss of Personal Encounters

Global trading platforms such as Amazon are standardizing capitalism and thus creating new freedoms. Online shopping and large digital trading platforms give consumers the freedom to order and find almost any goods and services anytime, anywhere. Even in the smallest villages on the periphery, it is now possible to conveniently order any label, any fashion brand, any electronic device, and any rare delicacy, and to stream any niche film. This "cultural participation" would have been unthinkable decades ago. Customers are gaining opportunities to rate products and thus a new form of consumer power. On the other hand, however, commerce is no longer based on personal contact, as is the case when shopping in an owner-operated store. Shopping is becoming depersonalized and delocalized. In a figurative sense, the technological possibilities of online shopping enable people to shop in an emotional and mental state

similar to that of the engineers in the literary works of Robert Musil or Max Frisch: As one-sided, number-crunching calculators who experience their "shopping adventures" in a fundamentally disoriented manner. However, we no longer see the retailers or the product in its haptic and sensory form, but only as a photo and in the abstract formulas and stars of product ratings. This category of technological consequences appears not only ambivalent but also as second-order tragic consequences. Of course, the question of what this means remains open. The disappearance of the so-called "corner shops" from the 1950s onwards in favor of supermarkets, often located on greenfield sites on the outskirts of towns, was lamented as a loss of quality of life and connectedness in villages, districts, and neighborhoods. Certainly, those who lamented this development usually also took advantage of the new shopping opportunities and only used the corner store to meet spontaneous needs. So they disappeared – are they still missed today? Has the quality of life declined as a result of their disappearance? These are questions that require a hermeneutic approach.

Loss of Quality in Favor of Measurable Data

The digital transformation, with its dependence on data, has further exacerbated the primacy of technical thinking: As soon as problems arise, there is a reflexive call for technical solutions (techno-solutionism), while other strategies, such as changes in human behavior, the economic order, or new political regulations, tend to be less likely to be discussed. This primacy is linked to the expectation that technology will then solve the problem. This attitude may obscure tragic developments or hermeneutic debates about the possibility of tragic second-order developments in favor of a belief in technology.

One aspect of this is that technology not only produces new tools, but also, through the undeniable multiple successes of many technology projects, creates an increasing dominance of the measurable and controllable in relevant decisions. The widespread belief in data that has emerged in the course of digital transformation is an expression of this, while the qualitative and interpretation-dependent aspects are finding it increasingly difficult to be accepted at all. In many cases, this is only discussed in terms of deficits. This influences, for example, academic and professional expert training in a way that in turn has a second-order tragic potential. There is no doubt that technical experts are needed to exploit the potential of technology for problem solving, prosperity, security, progress, etc. While they – metaphorically speaking – leverage, exploit, and establish potential, they also use technical language. Metaphors for human communities as "networks" – such as "social networks" or "career networks" – are also becoming established in general language use (Knox et al., 2006; August, 2022). As background metaphors, they influence thinking and action (Lakoff & Johnson, 2020) and promote ideas of people as links in mechanical chains rather than creative individuals.

In this way, technical and information technology background metaphors find their way into general thinking and speech. Thus, the successful work of experts can promote a "one-dimensionality" in the sense of the primacy of mechanistic thinking (see above) via the detour of language and cultural metaphors, marginalizing other forms of expression and modes of cognition such as the associative, the hermeneutic, the emotional, and experiences of historicity, questions of meaning (see Fig. 2). Tragic

experiences can arise here if technology, with its promises of progress, was also linked to emancipation (or even happiness) – but if the forms of expression in which these can be described fall victim to the primacy of "mechanistic speech and interpretation". The expert appears here as a chimerical figure. They make an irreplaceable contribution to social, economic, and technical progress, but create a dichotomy in public discourse and, above all, within organizations, where accepted and "embarrassing" rhetoric can no longer be expressed: Cognitive-rational argumentation supplants associative, emotional, and intuitive argumentation. Public trust can dwindle in this way. At the same time, the expert can "mutate" into a cynic who uses their privileged role to gain internal power and has effectively abandoned the ideals of the common good (Fig. 1b).

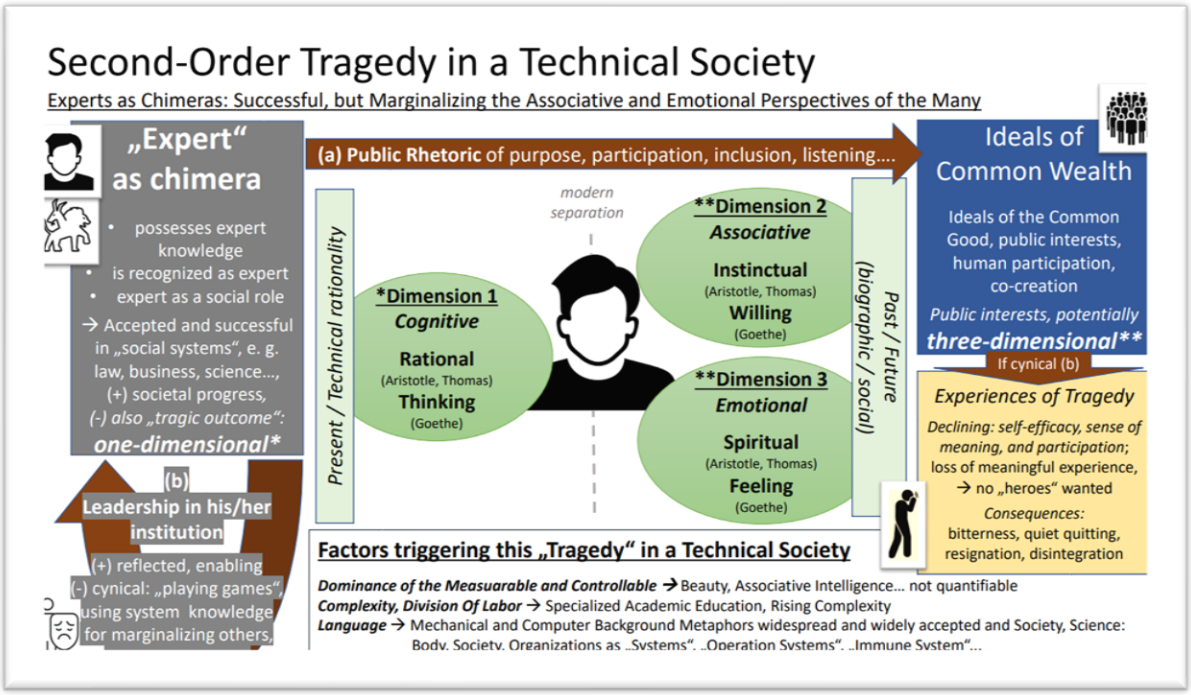

Figure 1b. Tragic second-order technological consequence (JG)

FROM FLIGHT TO CRASH: LITERARY FIGURES OF (PRE-)TRAGIC EXPERIENCE

Aristotle defined the effect of tragedy on the viewer as "pity and fear". However, this is not yet relevant to the phase preceding the "tragic fall" – the experience of the "successful use" of a new technology. This idea fits with the thesis that the tragic consequence of the second order does not occur as a sudden disruption, but rather gradually. This means that the "technical cause" of the tragedy is already present in the world before the tragic consequence occurs, let alone before it is generally noticed, feared, or publicly debated.

Thus, it is not the crash, but the experience of flying that appears to be a suitable metaphor for technological success, which already contains second-order tragedy. In this

section, we will examine the allegory of the experience of flying in more detail and interpret it as a specific experience of technological consequences using six literary or art-historical examples from different eras.

Why do we propose such hermeneutics? Because second-order tragedy arises in socio-historical constellations and experiences of them. It is not technology as such that leads to second-order tragedy, but rather its combination with human behavior. But the "key" is the perception of the actors (and/or observers). That is why second-order tragedy is "readable" in narratives about (experienced or literary) socio-technical constellations. The term "constellation", commonly used in sociology, refers to the interaction of various historical, social, political, and technical factors that, in specific combination, enable or shape a particular development (Heidegren, 2024). The technical possibilities and cultural perspectives of a specific time also shape a constellation, which focuses on the interdependence of actors and structures. From this perspective, technology does not appear as an isolated artifact, but as part of a network of relationships in which people are both acting subjects and actors shaped by technology. Second-order tragedy often arises in concrete constellations or figurations (Elias 1992/2018) where the scope for action of individuals and collectives is unintentionally restricted by technical developments.

This section explores such tragic consequences by attempting to understand the literary "internal perspectives" of the experience of weightlessness, but also of "thrust reversal", from an observer's point of view. The following subsections take closer looks at those tragedies:

- *Icarus* wants to expand his scope of action with a flying machine, but this forces him in one direction: Falling into the sea.
- *Kay* in Andersen`s "Snow Queen" wants to understand the world from a purely materialistic perspective, but in doing so loses his heart and his childhood – the direction is old age, and death.
- Preussler`s *Krabat* learns magic and wants to expand his scope of action materially – but he gets caught up in the mechanical and power apparatus of a mill, where death seems inevitable in the medium term.
- *Vakula*, on the other hand, succeeds in mastering a "flying machine" because he climbs aboard already knowing the dangers in Korsakov`s "Christmas Eve".

The texts – apart from the myth of Icarus itself – are taken from the opera libretto of Korsakov's "Christmas Eve" (1895/original novella 1835), Andersen's fairy tale "The Snow Queen" (1844), Max Frisch's "Homo Faber" (1957), and Ottfried Preußler's young adult novel "Krabat", known in English as "The Satanic Mill" (1971). We also look at Brueghel's painting of Icarus from 1550, thus taking a comparative look at works from different genres and eras.

In particular, the four "newer" texts do not deal with "technology" per se. However, they contain allegories or metaphors about flying that can be interpreted against the backdrop of the technological history of their times. They originate from different periods, during which different technological developments and discourses were at work in the background: In the 1830s, the Industrial Revolution provided decisive impetus, leading to the spread of steam railways in continental Europe and Great Britain. Around 1845, telegraphy made its breakthrough, enabling rapid transmission of messages over

long distances for the first time. Homo Faber is considered a parable of so-called technocratic high modernism: In the 1950s, especially in 1955, the beginnings of computer technology and the first civilian jet aircraft for mass transport were at the center of technical innovation. But the Second World War, with its devastating technological applications (bomber planes, submarines, developments in atomic weapons, Hiroshima, poison gas), was still fresh in people's memories. Finally, the 1970s were marked by microelectronics, the spread of personal computers, and the early beginnings of digital technology, which laid the foundations for today's information society. Preußler's "Krabat", on the other hand, is read more as a reworking of the Nazi dictatorship and the entanglement of a young person in its political-technical apparatus (Fritz, 2002, p. 48).

Flying is not only a metaphor for an experience, but also a central subject of the history of technology in the 19th and 20th centuries. Toward the end of the 19th century, the dream of flying gained significance when modern aviation linked social and national hopes to modern science. The "scientific balloon flights" undertaken by German aeronautical associations from the 1880s onwards were used for meteorological or geographical exploration (Höhler, 2001). In 1919, British pilots John Alcock and Arthur Brown succeeded in making the first manned flight across the Atlantic. The aviation history of German zeppelins ended in disaster. The crash of the Graf Hindenburg zeppelin (Fig. 2) in New Jersey on May 6, 1937, which killed 37 passengers, was seen by the media and the public as a warning sign, as the flying machine was considered a symbol of Germany's technological and military strength. A newspaper in Germany wrote the day after the accident: "The airship was more than a technology [...], children came to school with sad, pale faces." (De Syon, 2002, p. 196). The pale face – was it just an expression of "fear and pity" in the face of tragedy, or also an expression of an Icarus experience, that "the feathers melt"?

The flight (and crash) as a metaphor for the experience of technology would, in Hans Blumenberg's words, be an example of an absolute metaphor, i.e., one that cannot be completely dissolved into conceptual speech (Blumenberg, 2010). The metaphor of flying reflects – even beyond the technical context – the ambivalence of freedom. Only "the phantasm of being able to fly, which in dreams succeeds with the pleasure of effortlessness over vast spaces, allowed the idea of overcoming not only certain obstacles to earthly locomotion, such as rivers, seas, deserts, or mountains, but ultimately all of them – even the limitation imposed by the earthly, i.e., the body itself." (Trautsch, 2020a, p. 23). In extreme cases, it is a metaphor for victory over death. Modern flight technologies not only contribute to increasing the range of modern humanity, but also to the implicit project of "overcoming fear" through technical progress (cf. Blumenberg 2007/2018, p. 33). Also Saint-Exupéry's "The Little Prince", written by a long-distance pilot who died in a flight accident in 1944, can be read as an artwork that frames the dangers and technical uncertainties of aviation through the fairy-tale figure of the little prince. In the form of the fairy tale, this danger is not downplayed but reflected. Real threat, childlike joy, and the sensation of "weightlessness" are held in a lyrical tension with one another.

At the same time, modern flight technologies open up a greatly expanded space for fear of consequences. For 21st-century psychiatry, fear of flying is a clinical picture that

requires treatment in severe cases (Donker et al., 2023). In this context, we can see the reasons why the myth of Icarus is frequently taken up in 20th-century literature – by Salman Rushdie, Toni Morrison, and James Joyce, among others (Salis, 2016). As Natascha Adamowsky (2010) highlighted, in many visual figures of flying "premodern" images of "wonder" are still present.

Figure 2. Weightless over New York: The zeppelin "Graf Hindenburg" a few hours before the disaster (U.S. National Archives, Public Domain)

Daedalus and Icarus

The ancient myth of Icarus is particularly relevant. How does Icarus experience his flight (Fig. 3)? As a sudden occurrence:

> "[...] suddenly he found his feet were no longer on the ground ... he was in the air ... [...] He couldn't believe it! As he looked down at the sea below, his heart fluttered with excitement.
>
> It was as though his body was weightless. The wind whistled against his ears. He felt like a bird! Higher and higher, faster and faster he flew!
>
> Suddenly, Icarus realized he could hardly see his father. He had flown so high his father resembled a small dot below him. At the same time he noticed a feather drift past and float downwards towards the sea. And then another... and then another. Too late Icarus realized his wings were melting. […] With every desperate swoop of his arms, more feathers fell and soon his arms were almost bare." (Ovid 8/2012, p. 21)

The feeling of flight triggers excitement, heart palpitations, and a sense of weightlessness and exhilaration. But then his own father is out of sight, seemingly

unreachably far away. The flyer is caught in turbulence, a downward vortex. The aircraft is dysfunctional; his arms are "almost bare". The feeling of nakedness heralds disaster, the fatal crash, but also the loss of the "human scale": His father, whom he is searching for, is now only visible as a distant dot. Weightlessness gradually leads to disaster – the realization comes "too late".

Instead of or in addition to interpreting the myth of Icarus as a consequence of hubris, the Icarus experience can be interpreted as the disappointment of placing hope in a technical device. Icarus does not want to "become like God", as Lucifer does in the biblical myth of flying high (Pini, 2013). He flies out of sheer youthful joy. The shock sets in when he realizes that the technology does not deliver what it promises – when the wings fail. Icarus had not disregarded his father Daedalus' advice not to fly too close to the sun out of "malicious intent", but simply did not listen to him properly: "Icarus nodded quickly. In truth he was barely listening". The excited anticipation of the flight had distracted him.

Historical examples, but also the literary figure of flying, capture the ambivalence of technology. It embodies the empowerment of intelligently transcending what were previously experienced as "natural" limitations on movement. But it also embodies pure joy, pleasure, playfulness, and the rush of endorphins. However, talk of flying often already contains references to experiences that allude to the Icarian fall. Flying therefore means the feeling of:

- Losing the ground beneath your feet (metaphorically speaking, with regard to expectations of flight technology: Overestimating the strength of the device)
- Becoming weightless (i.e., losing sight of the consequences of one's actions)
- Seeing the Earth as nothing more than a distant point (i.e., losing one's earthly perspective)
- Gaining power, overcoming gravity (i.e., the temptation to keep going)
- Looking down on the world and others from above (i.e., hubris).

Real-life "flying adventurers" such as Elon Musk are seen as ambiguous figures who inspire both fear and hope. But many "modern Icaruses" do not attract attention. Humanity's "small flying machines" are commonplace and, for a humanity in need of mobility, there is no alternative – the automobile, the holiday plane, the flight simulator game on the iPhone, the toy drone. This means that flying is normal. A certain modern Icarus ignorance can be observed.

Figure 3. A calm fall to his death: Icarus by Albrecht Dürer, 1493 (British Library, London, Public Domain)

Brueghel the Elder: Landscape with the Fall of Icarus (1555)

The figure of Icarus is suddenly marginalized in Bruegel's early modern pictorial composition. Here, he appears barely larger than one of the sheep (Fig. 4). In contrast, the foreground is dominated by the plowing farmer, a shepherd, and the merchant ships on the sea. They all seem to go about their work unmoved, as if the fall of Icarus deserved neither attention nor significance. Here, the tragedy is ironically intensified: It is no longer even recognized: "None of those present, except the tragic flier, participate in his accident or share his tragedy" (Wilkoszewska, 1986, p. 29). On the one hand, the observers' reaction – pity and fear – is absent. On the other hand, Icarus' fate thus appears to be quite normal and everyday. This Renaissance depiction can also be interpreted as follows: In the "age of technology" the fall of exposed heroes becomes the fate of all. Think of sailors in a Spanish merchant ship that sinks, of growing cities that can be better fed thanks to new plant varieties from America, but are also more susceptible than ever in the event of pandemics. At the center of Brueghel's humanistic view is not the spectacular fall, but the continuity of everyday, useful activities such as plowing and sailing around the world – the technical achievements whose effects prove to be beneficial and promising. In a sense, the story of Icarus does not disturb us. Tragedy does not appear here as a moral warning against "hubris" but as an everyday companion to humans, whose actions are irrevocably ambivalent in a complex field of tension between knowledge, uncertainty, and acute (technical) necessity for action.

Figure 4. The beginnings of Icarus' ignorance: Painting "Landscape with the Fall of Icarus" (Bruegel the Elder, attributed – Royal Museums of Fine Arts, Brussels, Public Domain)

Gogol / Korsakov: Christmas Eve (1832/1895)

Rimsky-Korsakov's libretto for the opera "Christmas Eve", based on a novella by Nikolai Gogol, is staged as a single flight sequence – as in the Frankfurt Opera's production in the 2021/22 season. The play shows in a fairy-tale-like, comical form how a witch and the devil try to spread chaos and temptation on Christmas Eve, of all nights, by flying through the night. But the blacksmith Vakula, the heroic antagonist, also flies: Courageously on the devil's back, straight to the Tsarina, to steal her shoes and thus win the love of the village beauty Oksana. Here, the witches' flight is to be understood in the early modern symbolism of Christian interpretations (Zika, 1989), as a mythical representation of the temptation of evil to override divine laws. Korsakoff states:

DEVIL: Don't stop the devil leading honest people astray.
We'll fly, we'll fly!
Oo hoo!

SOLOKHA: We'll fly, we'll fly!
Oo hoo!

SOLOKHA: We're going to hide the moon and stars.
We'll unleash snowstorms,
the streets will be
full of snowdrifts. (Rimsky-Korsakov, n. d.)

It is the flight of the devil and the witch themselves that wreaks havoc, that "feels" like intoxication ("Oo hoo!") to the two of them, that removes the moon and stars from their places (Fig. 5). And the conqueror of the devil is the Orthodox hero, and his heroism is also a flight – the prudent, heroic flight, the flight on the back of a winged horse into which the devil has transformed himself. As a blacksmith, Vakula embodies creative power, but as someone dependent on Oksana's wishes, he also embodies dependence on "technology": He needs the devil himself as a "superhuman" means of transport.

On the night before Christmas, the still devoutly religious and superstitious pre-industrial man in Russia finds himself caught up in the mechanics of the coming, eerily technical order. Gogol's text can thus be read as an allegorical anticipation of the experience that the technical apparatus is both a means of liberation and an instrument of subjugation (cf. Sect. 2.2). The ambivalence of the flying allegory culminates in the fact that the hero of the story, Vakula, escapes the foolish superstition of his village by using the devil as his mount. He controls his flying object with a whip: "Wakula rushes across the stage on a flying horse, a whip in his hand, and disappears."

The story ends as a good, slightly ironic Christian heroic fairy tale. Its optimistic punchline: Humans remain free; it depends on the "how" of flying.

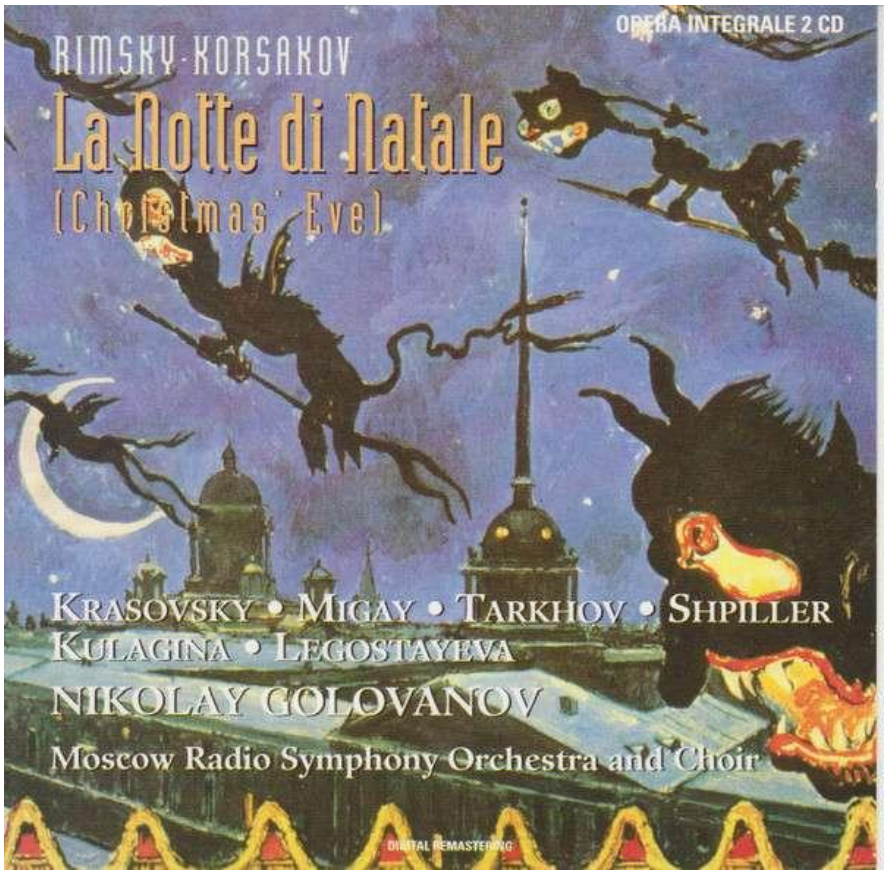

Figure 5. Everyone flies, and it depends on the "how": Witches and heroes in the opera "Christmas Eve" (Picture Citation, MRS CD Cover undated)

Andersen: The Snow Queen (1844)

The end of the first chapter of Hans Christian Andersen's fairy tale "The Snow Queen" opens up an allegorical interpretation that shows a person under the spell of a technical apparatus of power. The person here is Kay, who grows from a child into a teenager, whose childishness disappears as he adopts the "adult" view of purely technical, objectifying rationality. The emotional cooling – caused by the intrusion of a splinter from the devil's mirror – culminates in the experience of flying on the Snow Queen's sleigh:

> Kay looked at her; she was very pretty; he could not imagine a more clever, fairer face. She did not seem to be made of ice now, as she was when she sat outside the window and beckoned him. In his eyes she was perfect, and he felt no fear. [...] He gazed up into the immense spaces of the air, and she flew on with him, flew high among the dark clouds, and the storm wind whistled and roared as if it were singing old ballads. They flew over forests and lakes, over sea and land: below them the cold blast whistled, the wolves howled, the snow sparkled; above them flew the black cawing crows, but over all shone the moon, large and bright; and by its light Kay watched through the long, long winter night; by day he slumbered at the feet of the Snow Queen. (Andersen, 1844)

The feeling of flight is not conveyed from Kay's inner perspective. But that is only logical. His view as a flyer is transformed into complete emotional detachment, entirely devoted to mathematical reason, as symbolized by his love for the Ice Queen. The cold, the clouds, the altitude of the flight are described in a sober and inwardly impassive manner, reinforcing the atmosphere of horror and chill; Kay "feels no fear", observing the events coolly in the cold white moonlight (Fig. 6). His inner coolness is expressed through the allegory of the "long long winter night". The winter world rushes past him as if in a frenzy, with only one strange signal: The storm howls "as if it were singing old ballads". This may be Andersen's hint towards the end of this fairy tale: The narrative forces, the events of love, reconciliation and tears will provide the final punchline, not just the cool arithmetic of the Snow Queen's empire.

But first, the sleigh will take him to the Snow Queen's palace. There he must play a mechanical game for many years: The endless laying of pieces of ice that are supposed to form a meaningful whole. But he cannot succeed. He fails to lay the word "eternity". The tragedy of the second order lies in this combination of mechanical-technical promise (rational knowledge, higher order) and actual alienation, his insensitivity. But that is not the end of the fairy tale. His childhood friend Gerda finds Kay and redeems him with love and tears. But both have lost something on this journey: Their childhood. But they have also gained something: Experience, insight, and a sense of responsibility. On the one hand, this fairy tale can be seen as a variation on the "old" biblical story of the expulsion from paradise. On the other hand, it is full of allusions to the positivist, scientific-industrial hopes of salvation of the late 19th century. The experience of flight has changed from a joyful intoxication to a cool fascination. This suppresses the levels of awareness of compassion and beauty, as well as the playful approach to the world – a true "tragedy of the second order".

Figure 6. Kay's flight through the cold as an allegory for his inner life (Picuture Quotation Elena Ringo, Fairytale Wiki / Fandom)

Frisch: Homo Faber (1957)

Max Frisch presented the novel "Homo Faber" as a literary caricature of "homo technicus". The story begins with a flight. Homo Faber, the engineer, flies to South America as an ordinary passenger. The first-person narrator succinctly describes flying as a completely everyday experience with impressions such as: The flight is "rigid in empty space, no swaying", completely "motionless":

> As I could see out of my right eye, we were somewhere over the Mississippi, flying at a great height and absolutely smoothly, our propellers flashing in the morning sun; the usual window panes, you see them and at the same time look through them; the wings also glistening, rigid in empty space, no swaying now, we were poised motionless in a cloudless sky, a flight like hundreds of others; the engines running smoothly. (Frisch, 1997/2006, p. 3)

Soon after, he suffers the same fate as Icarus: His plane crashes. Ironically, even after surviving the crash, the passenger remains completely calm. His comment is laconic: "there was no serious damage":

> Without waiting for an order, we all gathered in the shade under the wing; not a word was spoken, as though talking in the desert was forbidden. Our Super Constellation was tilted slightly forward, there was no serious damage, only the

> front undercarriage was jammed, having sunk into the sand, it wasn't even smashed up. The four propeller crosses gleamed in the glaring blue sky; so did the three rudders. No one moved, including me. (Frisch, 1997/2006, p. 9-11)

Not only flying, but also crashing becomes somehow normal here (Fig. 7). The enlightened engineer simply takes note of it with a shrug, as if he knew that it was a possibility with a certain probability. The mode of being affected – necessary in order to be able to interpret tragedy at all – has been lost to this modern type. Homo Faber, as a caricature of the technically rational engineer, does not allow this experience to distract him from his thoughts; he accompanies the crash with reflections on technical details, objectively, like an observer of a laboratory experiment. The engineer Faber embodies a modern world in which "tragedy" is presumed impossible. Yet he unknowingly falls in love with his own daughter (a kind of Oedipus story), she is bitten by a snake (like Eurydice). Ancient tragedy breaks into the modern world, but Walter Faber testifies a complete blindness to tragedy because he lacks the sensitivity for it. Ironically, this persists in Frisch's novella itself after a literal Icarus experience, his own plane crash.

The engineer – as an almost naive developer of technology – is, in this sense, the tragic figure of modernity. On the one hand, the engineer is even a savior figure of the era of "technocratic high modernism", as historians Uwe Fraunholz and Sylvia Wölfel have called it. Until the mid-1970s, the engineer embodied the competence to solve the great questions of humanity – energy supply and world food supply – in the public eye. On the other hand, however, the engineer is also increasingly portrayed as a problematic figure in literature. Max Frisch's novel "Homo Faber" not only alludes to Icarus, but is also read primarily as an adaptation of ancient myths: Precisely because "his" protagonist is incapable of any other approach to the world than a technically rationalized one, Max Frisch allows this character to be caught up in a whirlwind of tragic events in the course of the narrative, ranging from incest (Oedipus) to suicide and his own death. The punchline is that it is precisely in the completely demythologized technical approach to the world that myth regains ground: "Myth and technology are thus not opposites, as the narrator sometimes suggests, but are similar in their function of alleviating fear" (Roehl, 2020, p. 267).

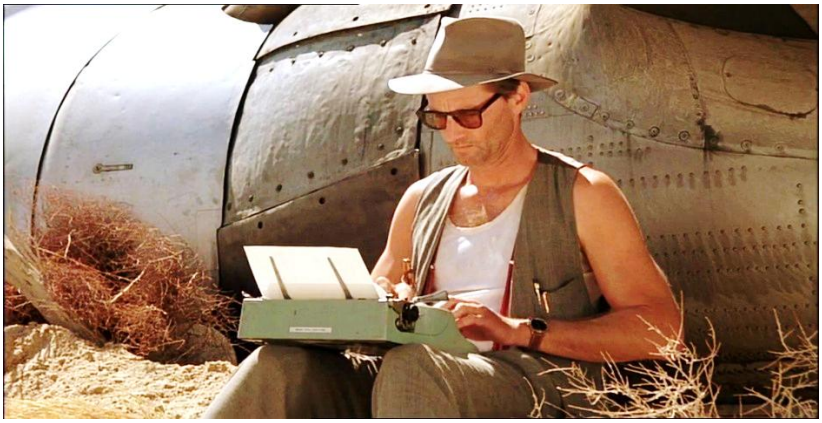

Figure 7. Homo Faber, detached participant-observer of a plane crash (Image Quotation of Volker Schlöndorff's 1991 movie)

Preussler: Krabat / The Satanic Mill (1971)

The young adult book Krabat, which is very well known in German-speaking countries and translated into English as “The Satanic Mill”, describes the story of a poor young man who hopes for a better life by entering a dark mill (Fig. 8). There, one learns magic and flying, but the price is high. The sorcerer is directly subordinate to the devil and must sacrifice one of his students once a year. There, the young Krabat not only learns magic and enjoys a privileged life, but is also suddenly “thrown” into adulthood. This is also associated with the experience of near death. His thirst for adventure and desire for a life without material poverty turns into a life of bondage and fear. Behind the magic course lies a totalitarian system in which everyone fears being denounced by the others. In this story, hope (a life without poverty) and tragic consequences (death and constant fear of speaking freely) are tragically opposed.

Flying is also to be understood allegorically here: The children learn to transform themselves into ravens through a magic spell. The mill where Krabat is apprenticed can be understood symbolically as a strictly functional system. The mill grinds incessantly, its processes are determined by a rationality that leaves little room for individual action. In this setting, humans become “functions” of the apparatus. They gain power and abilities, but pay for them with autonomy and vitality (cf. the section about “Second-Order Tragedies”). The tragedy lies in the dual experience: On the one hand, entering the mill promises progress, power, and security; on the other hand, the apparatus binds the individual into structures that increasingly curtail their options for action. In this reading, “Krabat” appears as a narrative depiction of second-order tragedy. Here, flight is portrayed as a brief, bumpy attempt – paradoxically as an expression of bondage and imprisonment by death:

> Krabat, the raven Krabat, obediently spread his wings and took flight. Fluttering awkwardly, he flew around the chamber, circled the table, and brushed against the book and the skull. Then he settled down with the other ravens and clung to the perch. (Preußler 1971, p. 40; translation JG/AG).

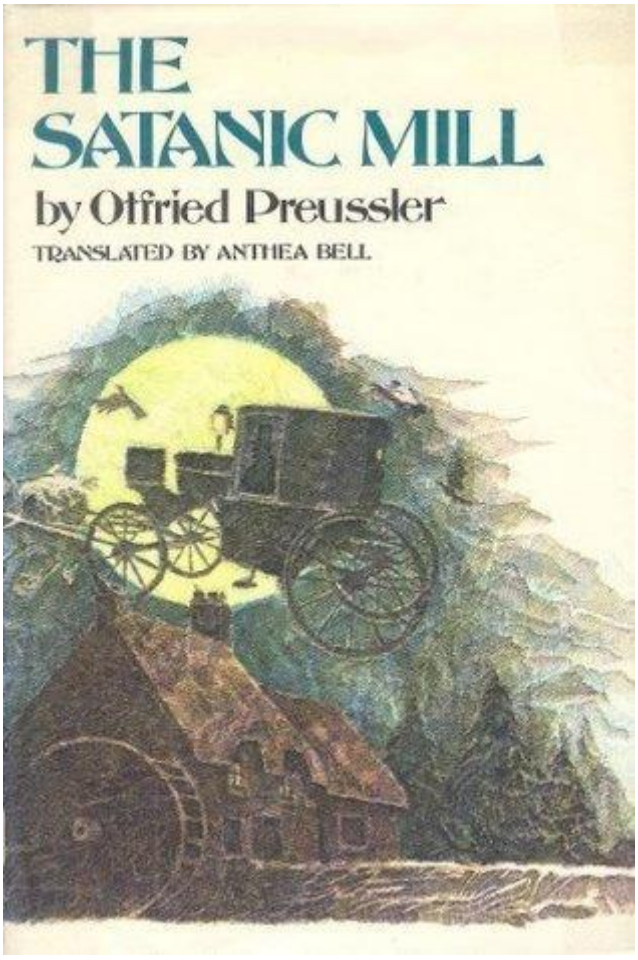

Figure 8. Flying over the Satanic Mill (Image Quotation of Mc Millan book cover 1973)

DISCUSSION AND CONCLUSION

Second-order tragedy in the context of technology has been described in this article as experiences of loss of freedom and individuality, the future, personal effectiveness, or a loss of relevance of qualitative data in decision-making processes. Such tragedy does not arise suddenly, but gradually. It emerges in historical or literary constellations from the feelings of those involved, in the interpretation of the observer, and in hermeneutic dialogue.

In considerations of the consequences of technology, for example, the view of digitalization and AI must not be narrowed down to a purely objectivist view of technology, but must take into account the interactions with human behavior. The possible constellations of application are in principle infinite and unpredictable. Knowledge of historical and literary cases broadens the corridor of expected consequences in the "first and second order". The often only vaguely tangible human

factors in terms of convenience, adaptation, and overestimation of digital systems, perhaps most strongly the "sweet temptation" of convenience, adds another layer to the usual difficulties of recognizing gradual processes and assessing their relevance for action. This shows that the tragedy of technology is actually a tragedy of humanity.

Speaking of technology and tragedy together also has several implications with regard to the quality of public discourse:

- This perspective removes it from one-sided scandalization.
- It places it in the larger context of meaning, experience, and history of the tragedy of humanity in general.
- It has a definable, "objectifiable" side
- It has an "inner" subjective side, which we call "second-order tragedy".
- It is precisely this narrative structure of the tragic experience with technology that differentiates the usual dichotomous discourse patterns between "rejection" and "approval", between "fear of technology" and "technological euphoria".
- It expresses ambivalence from an experience-based perspective.

Second-order tragedy was received and interpreted using the example of literary descriptions of flight. This provided an example of hermeneutic technology assessment. In doing so, we have responded to a methodological research postulate: To strengthen a hermeneutic science of technology assessment (Grunwald, 2014; Mehnert & Grunwald, 2024).

However, we must also mention the possibility that people are projecting the tragedy of general life experience onto technology in a monocausal manner. Statements such as "robots are taking our jobs" (instead of "managers who decide to use these robots"), or "my child has ADHD because of tablets" (instead of "because we gave them a tablet too early", or "because we don't have the energy to deal with him appropriately"), or "I am sick because of industrially-processed ready meals" (instead of "because of my one-sided dietary choices for these meals") would be examples of this. Here, we could speak of technology-related exculpation narratives. Our idea of a dual relationship between tragedy and technology does not imply a one-sided negative focus on technology. Embedding technology in human history as the history of technology allows us to recognize "technological progress" as part of the provision for a better life. For tragedy would exist even without technology, only in a different form.

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