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Research article

„About Orffyreus' gift I have been keeping, / at the same time laughing and weeping.“ The Perpetuum Mobile – A Small Phantasmagoria from the Eighteenth Century

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Abstract

The perpetuum mobile reappears throughout history as a dream of technical reason. On the face of it, it relieves us for good of the drudgery of work but it signifies more generally the quest to get something for nothing, to achieve benefits without cost. This pervasive desire informs technical optimism, it is frustrated in the most mundane ways, but it never gives up. Inventors imagine that there is always just one small missing cog that would save the design, in the meantime they employ hapless laborers to secretly drive their machines. These are the ones that finally present the bill to the visionary dreamers. This becomes evident in a survey of mostly 18th century proposals, most famously that of Johann Ernst Elias Beßler or Orffyreus. Even before the age of thermodynamics and proof of the impossibility of the perpetuum mobile, Georg Christoph Lichtenberg was among the majority of 18th century scientists who would meet any such proposals with incredulity. Accordingly, he engaged with such claims with an in equal parts curious and satirical attitude. And even after the age of thermodynamics, the perpetuum mobile persisted in the artistic imagination, for example, of Paul Scheerbart or Leonid Leonov.

Keywords: Perpetuum Mobile; Johann Ernst Elias Beßler; Paul Scheerbart; Leonid Leonov; Georg Christoph Lichtenberg

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Научная статья

“О даре Орфиреуса, который я хранил, / одновременно смеясь и плача”. Вечный двигатель – Маленькая фантасмагория восемнадцатого века.

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Аннотация
Вечный двигатель появляется на протяжении всей истории как мечта технического разума. На первый взгляд, он навсегда избавляет нас от тяжелой работы, но в более широком смысле он означает стремление получить что-то бесплатно, добиться преимуществ без затрат. Это всепроникающее стремление порождает технический оптимизм, терпит крушение самыми обыденными способами, но никогда не сдается. Изобретатели воображают, что всегда есть одна маленькая недостающая шестеренка, которая спасла бы конструкцию, а тем временем они нанимают незадачливых рабочих, которые тайно управляют их машинами. Именно они в конце концов предъявляют счет мечтателям-визионерам. Это становится очевидным при рассмотрении предложений, в основном, XVIII века, наиболее известное из которых принадлежат Иоганну Эрнсту Элиасу Бесслеру или Орфиреусу. Еще до эпохи термодинамики и доказательства невозможности вечного двигателя Георг Кристоф Лихтенберг был одним из большинства ученых XVIII века, которые с недоверием относились к любым подобным предложениям. Соответственно, он занимался такими утверждениями с равной долей любопытства и сатирического отношения. И даже после наступления эры термодинамики вечный двигатель сохраняется в художественном воображении, например, Пауля Шеербарта или Леонида Леонова.

Ключевые слова: Вечный двигатель; Иоганн Эрнст Элиас Бесслер; Пауль Шеербарт; Леонид Леонов; Георг Кристоф Лихтенберг

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A TECHNICAL DREAM OF REASON

The irradicable drudgery of work – depending on your temperament, it is a source of sadness or enervation. We have to live with the thought that we have to always keep making a new effort so that the dust which we just wiped with great patience will not settle again tomorrow. With the thought that the work never ends, that fresh energy needed to be invested continually for a myriad of of various more or less unpleasant tasks. This drudgery of work has again and again given rise to daydreams of elves and servant golems, of robots and a reservoir of inexhaustible energy that turns everything into child's play. (Many things have become easier, but then the term “energy crisis” was coined in the twentieth century, which put in circulation its own hectic imaginaries of gigantic amounts of energy, be it from hydrogen or from biomass.) And so the following reflection shall be dedicated to the abandoned dream of the perpetuum mobile, of the machine which, once set in motion, runs continuously without any further energy input – which thereby mostly puts to rest our problems of work.

The great historian of technology Franz M. Feldhaus notes with angry fervor that the idea of the perpetuum mobile has surfaced again and again since the Middle Ages. After identifying the first instance of this idea around 1245 he encounters it “in numerous places and in the most outrageous variations, with magnetism, levers, moving balls, water wheels, water screws, lifters, etc.” (Feldhaus, 1914, columns 784-785). The de facto “impossibility” of such a machine had been proven.along with the formulation of the first law of thermodynamics by Hermann von Helmholtz, Robert Mayer, and James Prescott Joule in the nineteenth century. The only “perpetua mobilia” that we still have today are, if you will, the barometer and the thermometer.

Of these, the barometer received this (long since abandoned) designation by Otto von Guericke. By this he meant nothing other than another Latin term that was commonly used for the barometer: semper vivum, always alive, in constant ups and downs. The same applies to the thermometer, for which the name perpetuum mobile can be found around 1604. A letter about a machine with the name in question belongs here. Georg Christoph Lichtenberg wrote it on December 20, 1774 to Abraham Gotthelf Kästner from England: “I have seen Mr. Cox's perpetual motion and examined it as far as is possible in such a matter. (For it is shown, as one shows exotic animals in Göttingen.)” (Lichtenberg. 1983, no. 267). It is a barometer, “perhaps,” as Lichtenberg writes, “the most expensive that has ever been made, for it contains two hundredweights of mercury.” In this device the changes of air pressure are used to do the work of winding a clock spring. However, “[t]hat this thing deserves the name of a perpetui mobilis is something that no one would claim who knows that watermills are not wound up either, nor set in any way.” Like the water cycle, air pressure belongs to the constant contingencies of the planet. Like the climate, barometers and thermometers are in “constant motion.” But the dream of a machine that always keeps „moving onwards“ is quite another story.

George Douglas's fabulous novel „The House with the Green Shutters“ (1901), presents in a casual vignette the image of a sad delusion (against the characteristic Scottish background of a society with a Calvinist work ethic that still haunts even the idle daydreamers):

> In every district almost you may find a poor creature who for thirty years has cherished a great scheme by which he means to revolutionise the world's commerce, and amass a fortune in monstrous degree. He is generally to be seen shivering at the Cross, and (if you are a nippy man) you shout carlessly in going by, "Good morning, Tamson; how's the scheme?" And he would be very willing to tell you, if only you would wait to listen. "Man", he will cry eagerly behind you, "if I only had anither wee wheel in my invention – she would do, the besom! I'll sune have her ready noo." Poor Tamson! (Douglas, 1901, p. 93)

Here one sees – the tell-tale sign is the wee wheel, the one small missing cog – to the shrunken form of that old dream of technical reason that had its heyday at the time of Lichtenberg who lived in the second half of the 18th century.

We are used to considering this time the century of enlightenment, but it is also the century of Cagliostro – which has along the way produced something like a new form of superstition, one that feeds precisely on the urgent expectation of radical scientific renewal. And the classical age of the perpetuum mobile – after becoming, as mentioned, an object of physical speculation already in the High Middle Ages – is at the same time the age of absolutist mercantile politics, as such like the preceding age of gold-making. For any enterprising and in their appearance somewhat mysterious trader of secrets the ideal condition for the exploitation of this elusive dream consisted in the desire of absolutist courts to amass a huge state treasure as quickly as possible, bypassing laborious processes of production. The search for the perpetuum mobile remains attached to El Dorado fantasies: the dream of this machine is a gold rush that unfolds no longer in the colorful imagery of a seafaring imperialism, nor like alchemy in a magical vein and that of natural philosophy, but in the manner of physics and apparently within exact outlines. And yet, according to some contemporary writing, the machine still inhabits one of the “eight secret chambers of the edifice of nature” (Bülau, 1893, p. 71) , along with the philosopher's stone, the alkahest, the art of softening glass, eternal light, the hyperbolic line in a concave burning mirror, the *longitudo maris* and the squaring of the circle. Feasible solutions and wishful thinking here appear side by side and intermingle. Only a small step from the philosopher’s stone to the *longitudo maris*, that is, the calculation of longitude at sea which is decisive for precise navigation (Sobel, 2005). One or two rooms in the edifice of natural mysteries feature real and actually solvable problems. In others rooms reigns hopeful absurdity. There is hardly a clearer demonstration of science and superstition thus amalgamated than in the career of the most famous of all those who traveled with a perpetuum mobile in their bagful of projects – Beßler, oscillating between the Kabbalah and physics, between treasure hunting and mechanics, between anxiously eager tinkering and blatant fraudulence.

IMPRESARIO OF THE MACHINE

Johann Ernst Elias Beßler, who later assumed the extravagant name Orffyré, was born in 1680 in the area of Zittau where he attended the Gymnasium as the gifted son of a farmer, with an extraordinary degree of support from Christian Weise, the still remembered dramatist, poet, and author of enlightenment textbooks who had been the

school‘s rector since 1678.[1] However, Beßler lacked the means to continues his education at the university, and went on leading an unsettled, itinerant life here and there all over Central Europe, with forays into a monastery and the army, but above all constantly occupied with diverse arts and crafts (among many others the long list includes copper engraving and gunpowder manufacture, clockmaking and astrology,). He must have been an unusually skilled and gifted technical practitioner, also endowed with a theoretical curiosity that led him to dream of a revolutionary invention, but also with a penchant for the dubious activities of a treasure hunter and charlatan. With these versatile skills he managed to here and there move into aristocratic circles, and it is said that when serving as a travel-companion on a grand tour of Italy he came upon a seemingly self-moving roast grill and thus conceived the plan to construct a perpetuum mobile. His meandering journeys, which cannot be traced exactly, took him far and wide and involved him in a variety of – often precarious – living-conditions. His itinerant life as an artisanal mechanic and market crier finally found a firm footing when in 1712 in Annaberg, Thuringia, he managed to heal by way of a seemingly miraculous cure the sick daughter of the mayor (who was himself a doctor!). The cured patient marries her savior who thus achieves a certain steady prosperity, and in the following year he exhibits in Gera for the first time his perpetuum mobile, the mechanics of which he had probably been devising for many years. Over a period of several years, Beßler exhibits bigger and bigger machines in various locations, and in front of more and less sceptical experts – including the philosopher Christian Wolff (although the possibility, in principle, of such a machine is not yet in doubt, only sometimes its successful realization by Beßler), and in 1715 he gets lucky in that a prince devoted to the arts and sciences takes an interest in his invention. The landgrave Karl of Hesse-Kassel appoints him to his court on the recommendation, among others, of Leibniz. Born in 1654, Karl ruled from 1670 to 1730 and during this time built the Kassel Wilhelmshöhe park with its cascades. After the revocation of the Edict of Nantes he successfully recruited the Huguenots fleeing from France, making Kassel, next to Berlin, the city with the largest Huguenot population in the empire, pushing for the development of a significant textile industry, establishing factories for the arts and crafts such as faience production, glass finishing, amber cutting, tapestry weaving, thus attracting to his court a large number of travelling artists and architects. He is the typical embodiment of a prince who is at the same time a refined and enlightened mind, and a ruthless ruler. He promotes the fine and useful arts, and because such beneficial activities cost a lot of money, he sells entire regiments of his own subjects to Prussia and England – which was a sinister tradition of Hesse-Kassel as we remember how many Hessians fought on the British side in the American War of Independence, for example in the legendary battles of Trenton and Princeton immediately after Washington crossed the Delaware River in 1776.

In 1717, Landgrave Karl called for an experiment to be conducted at Weissenstein Castle which would become the probably most famous experiment in the history of perpetual motion: In a room with doors and windows sealed, Beßler's perpetual motion,

[1] My presentation of Beßler’s biography primarily follows the section "Beßler-Orffyré" in Bülau 1893, beginning on p. 69, as well as Michal (1976), p. 99 onwards.

a gigantic wheel, was to be tested, that is, kept in continuous motion for a long period of time, in the presence of the sovereign and his ministers as well as the Dutch physicist Willem Jacobus s'Gravesande and the architect Fischer von Erlach who was in Kassel to install a steam engine. And indeed, when the room was opened after the set period of "twice six weeks," Orffyré's wheel was still fully active. On May 27, 1718, the Landgrave issued a certificate to Beßler who, in turn, published in 1719 "Triumphans perpetuum mobile," perhaps the classic among his many other pamphlets such as the "Substantial Report of the ... felicitously invented Perpetuo ac per se Mobili, along with its accurate illustration [*Gründlicher Bericht von dem ... glücklich inventirten Perpetuo ac per se Mobili nebst dessen accurater Abbildung*]" (1715). It is fascinating and at the same time quite bemusing to read these programmatic and triumphant tracts since Beßler is also a master of endless, poetically pedestrian doggerel verse which he uses to confront his critics:

> Mister Gärtner asks: how long a time
> the work of my art should run on fine
> namely
> without the help of all such stuff
> of which millers and clock-makers make enough. (Orffyreus, 1716-1717, p. 52)[2]

This arbitrarily chosen example appears in a volume which features a most characteristic title to preface its second part, and for the purpose of characterizing Beßler this heading shall be rendered here in full:

> By Christian Wagner in Leipzig frivolously, dishonorably, dishonestly disparaged, libeled, yet in vain supposedly exposed, Now however saved, defended, justly and truthfully remaining Still unexposed: The Orfyrrean PERPETUUM MOBILE. Upon the urgent pleading by many great benefactors with utmost necessity and greatest speed composed in fine German verse by the inventor of the Perpetuum Mobile, ORFFYREUM himself. (Orffyreus, 1716-1717, titlepage part II)[3]

If this and other pamphlets afford a poetic polemic, there is, in contrast, the rather more gravely celebratory form of a Latin-German treatise like the one that reports about the experiment at Weissenstein castle, the title of which is rather more stilted:

> The triumphant PERPETUUM MOBILE ORFFYREANUM addressed to all potentates, heads of state, regents and personages of worldy importance etc. With all due submission Presented for eventual negotiation and designed as a proposal by its inventor, ORFFYREO, that is TRIUMPHANS PERPETUUM MOBILE

[2] "Herr Gärtner fragt: wie lange wol / Mein Kunst-Werck stetig laufen sol / Nemlich / ohn Zuthun solcher Sachen / Die Müller und Uhrmacher machen."

[3] „von Christian Wagnern in Leipzig Leichtfertiger-, Ehrvergessener- und Lügenhaffterweise herunter gemachte, verleumbdete, doch nur vergeblich entdeckte, Nunmehro aber auch gerettete, defendirte, gerechte und wahrhafftig-bleibende Noch unentdeckte ORFFYREIsche PERPETUUM MOBILE. Auf inständiges Ansuchen vieler großer Gönner höchst-nöthigen Falls eyligst in fein deutschen Verßen entworffen von dem Inventore des Perpetuum Mobile, ORFFYREUM selbst."

> ORFFYREANUM omnibus Summis Orbis universi Principibus Magistratibus et Statibus debita cum Submissione Venale propositum, una cum varis ejusdem effectibus per Authentica testimonia confirmatum ab ejusdem Inventore ORFFYREO. (Orffyreo, 1719)[4]

A survey of these works in their context provokes laughter and a sense of vertigo. But despite all their posturing and urgent sales propositions, and despite their being anchored firmly in the customary scholarly constructions of the time, they yet appear like a mirror which by way of distortion reveals surprisingly clearly certain features of a natural science on the occasions where it operates altogether rhetorically.

All these writings appeared under the name "Orffyreus" that had been adopted some time earlier to replace the rather plain "Beßler." The exotic-sounding new name resulted from encryption, namely a simple shifting of the alphabet by thirteen places so that A = N, B like Beßler becoming the O of Orffyré, and so on.[5] And so „Beßler" becomes a refined "Orffyré," and this then only needs to be latinized to „Orffyreus."

The literati who encountered the wheel of Orffyreus were rather skeptical because of the impossibility of examining the inside of the machine, yet were sometimes quite impressed. In a 1721 letter to Newton, for example, the physicist s'Gravesande still referred to the Kassel wheel as something admirable (see Michal, 1976). Six years later; in his work *Sur la possibilité du mouvement perpetuel* [Regarding the Possibility of Perpetual Motion] he did not rule out a perpetuum mobile, as long as there is no requirement that for its construction one should assume only mechanical elements, allowing for a magnetic conception of such a machine that had been under discussion for over a century (see Michal, 1976, p. 168). But s'Gravesande's was one of the last scientifically serious works that argued at the – albeit shaky – level of contemporary knowledge to concede the possibility of a perpetuum mobile.

So what about the "Kassel wheel"? Unfortunately, there is an infamous document that tears the veil of physical mystery as it seeks to create an impenetrable weave. It gradually became evident that several people, including Beßler's brother and his wife, took turns cranking the large wheel from an adjoining room. Although the wheel, with its considerable weight and clever arrangement, would have rotated for an astonishingly long time under its own weight, it finally would have come, of course, to it inevitable standstill. This explains why Beßler hesitated to accept the pressing invitations of Tsar Peter I who was very interested in a perpetual motion machine. He had offered a prize for such a machine in 1713, hearing of Beßler's invention on a trip to Western and Northern Europe in 1716/17. It also explains why the inventor always refused to have his construction examined by experts. Among the secret employees who had to turn the machinery for two pennies an hour – often for whole days – was the maid Anna Rosine Mauersberger, who

[4] „Das Triumphirende PERPETUUM MOBILE ORFFYREANUM an alle Potentaten, hohe Häupter, Regenten und Stände der Welt etc. In gebührender Submission Zu etwanniger Erhandlung vorgestellet und als ein Antrag entworfen von dessen Inventore, ORFFYREO bzw. TRIUMPHANS PERPETUUM MOBILE ORFFYREANUM omnibus Summis Orbis universi Principibus Magistratibus et Statibus debita cum Submissione Venale propositum, una cum varis ejusdem effectibus per Authentica testimonia confirmatum ab ejusdem Inventore ORFFYREO."

[5] I thank Ulrich Joost for pointing this out.

evidently began to talk. The document has been preserved in which she had to deliver an awful oath of secrecy to Beßler (see Michal, 1976, p. 106, and Bülau, 1893, p. 78-79). In it she swears

> by the triune God, dearly and with good deliberation that from this hour onward until my death, yes, for eternity, I will not speak, write or indicate anything evil about you, hitherto my master, who stands here before me; and I will not discover, reveal, speak or write anything to any creature, whether it be living or not, about your actions and omissions, arts and secrets, but everything and anything that I know and have seen or heard of your secrets I will keep silent and buried within myself, just as you desire or require of me [...][6]

And thus the formulation of the oath continues on for a long time. Indeed, for a while, everything went well. Around 1720, Beßler was at the height of his fame; an engraving portrays him as "High Princely Hessian Commercial Councillor, MP Mathem. and Inventor of the Perpet. Mobil." Despite the revelations that gradually leaked out and exposed him, he still enjoyed until the Landgrave's death in 1730 a somewhat favorable standing at the court in Kassel. The people there perhaps did not want to discredit themselves by throwing out the impostor. Also, in light of his undoubtedly versatile technical skill, the hope had perhaps not died that he was still good for something unsuspected.

And even after Karl's death he continued to live for a good while in Karlshafen on the Weser (another Huguenot settlement), where the Landgrave's generosity had granted him a property. He kept announcing adventurous machines – in 1739, for example, a submarine: "Neptune rendered powerless through an almighty wonderous power [Der durch allmächtigste Wundermacht ohnmächtig gemachte Neptunus]." He also tried himself as an ecumenical religious philosopher (one of his manifestos is called "The righteously believing Oryfférean") planning to found a school of wisdom in Karlshafen. Shortly before his death, he moves on again, to northern Germany. Beßler's career belongs to a time when the British as the most advanced nation of capitalism referred to his social type – what today we would call „entrepreneur" – alternately as „undertaker," „projector," and „adventurer." The last years of his life were marked again by a confusing multitude of plans, which as in his early years show him to be one of those tireless project-makers for whom capitalist rationality and adventurous fortune-seeking come together. In 1743, for example, he wants to set up11 a factory in Braunschweig for marble slabs, Russian and Morocco leather. He died almost impoverished in 1745 in Fürstenberg, buried in the Karlshafen hereditary burial plot which he had acquired in happier times.

Even if we identify Beßler as an early capitalist entrepreneur, his emphasis is so strongly on the adventurous that we can use his case to reveal the extent to which

[6] She swears „teuer und mit gutem Vorbedacht bei dem dreieinigen Gott, daß ich von dieser Stunde an bis in meinen Tod, ja in Ewigkeit, von Euch, meinem bisherigen Herrn, der Ihr hier vor mir steht, nichts Böses reden, schreiben oder zeigen und zu einiger Kreatur, sie lebe oder lebe nicht, von Eurem Thun und Lassen, Künsten und Geheimnissen etwas entdecken, offenbaren, reden oder schreiben, sondern alles und jedes, was ich weiß, und bei Euch Geheimes gesehen und gehöret, ich in mir verschwiegen und verborgen halten will, so wie Ihr von mir begehret oder verlanget […]"

speculation on good luck and pure chutzpah are part of entrepreneurship. He reportedly announced to Anna Rosine Mauersberger that he would shoot her if she betrayed him, with her objecting that he would then be executed as a murderer, and him responding that this mattered not, since he has to die sometime – all this makes him a desperado for the science of miracles. He may well have believed now and then in his own lie, according to which the wheel was turned from the outside only to protect it, and that in principle his perpetuum mobile worked – perhaps only one small cog was missing. The stakes were high, after all, because in the end everything was at stake, a whole new world. In war and peace the most astounding things would become possible. As late as 1817 Christian August Vulpius in his "Curiosities" quotes the announcement of the perpetuum mobile by a certain Peter from Brussels who was born in Mainz:

> That perpetuum mobile consists of a wheel which is seven feet in diameter and two feet thick; it runs on its own original power and without the aid of springs, mercury, fire, electricity, galvanism, etc.; it yields the force of more or less a thousand horses; its speed is incredible […] Such a [machine] can serve emperors, kings, and princes in war, save human blood, facilitate and promote victory. It can be armed with sabers and thus form entire squadrons of cavalry without anyone directing the sabers [...] It is particularly useful for the commercial sector as it can obtain goods from distant countries less costly [...] If this machine had been invented already in the sad year that just passed, it would have relieved the great general hardship by much […] (Vulpius quoted in Buchner, 1927, vol 2, pp. 321-323)[7]

The stream of such promises, which always reflect the most urgent needs of their time, flows on and on. But these grandiose ideas, which are advanced again and again, are increasingly perceived as nothing but mere curiosities. The scepticism of science or even of so-called common sense becomes insurmountable by the middle of the eighteenth century, even though the Royal Academy of Sciences in Paris gravely holds out until 1775 with its final refusal to deal with the subject any further: "La construction d'un mouvement perpétuel est absolument impossible [The construction of a perpetuum mobile is absolutely impossible]." A good example of a sober summing-up from as early as the middle of the century can be found in a somewhat surprising place, namely Jacob von Eggers' "*Neuem Kriegs- Ingenieur- Artillerie- See- und Ritter-Lexicon* [New Dictionary for War, Engineering, Artillery, Marine-Matters, and Knighthood]." This dictionary of the military sciences, broadly speaking, includes in its second volume

[7] „Jenes perpetuum mobile besteht aus einem Rade, welches sieben Fuß im Durchmesser und 2 Fuß Dicke hat; es läuft durch seine eigne Urkraft und ohne Beihülfe von Federn, Quecksilber, Feuer, Elektricität, Galvanismus etc. fort; es kann eine Kraft von mehr oder weniger als tausend Pferden damit hervorgebracht werden; seine Schnelligkeit ist unglaublich [...] Für Kaiser, Könige und Fürsten kann solche [Maschine] im Kriege dienen, Menschenblut ersparen, und den Sieg erleichtern und befördern. Man kann sie mit Säbeln bewaffnen, und dadurch ganze Schwadronen Cavallerie bilden, ohne daß die Säbel von jemandem geleitet werden[…] Für den Handelsstand ist sie besonders nützlich, indem er die Waaren entfernter Länder wohlfeiler beziehen kann [...] Wenn diese Maschine schon in dem vorigen traurigen Jahre erfunden worden wäre, würde sie die allgemeine Noth um Vieles haben lindern können [...]"

"Perpetuum mobile" as an entry of its own.[8] This entry reads in full (in a peculiar staccato style, rich in commas):

> Perpetuum mobile, the perpetual movement, le mouvement perpétuel, refers in mechanics, in the precise and proper sense, to a machine which, merely by virtue of its own structure, once set into motion, continuously carries on this motion, in such manner that this movement would go on eternally if the matter of which the machine consists never diminished and nothing in its structure would get damaged. Such a machine has been sought like the Lapis Philosophorum [the Philosopher's Stone] from ancient times and a long while with much effort and expense, but in vain; and many of the newest and most learned mathematicians fairly consider it to be an absolutely impossible matter, the impossibility of which they have also sufficiently demonstrated. (as long as the rubbing or friction of machines, the resistance of the air, and other causes which constantly impede motion cannot be completely avoided). Each motion by itself would last forever if there were no external cause to weaken it little by little, to modulate its course, and finally to annihalate it. (Eggers, 1757, vol. 2, cols. 380-381)[9]

The last remnant of those dramatic hopes for saber-armed machines with which one could "form entire squadrons of cavalry" had already been "annihalated" in this military encyclopedia. What comes now until the end of the 19th century is a long succession of claims that are sham or fiction. The imagination of the scamming inventors must capitulate to the insoluble problem, but becomes focused instead on ever more subtle tricks (whereby the subtlety may occasionally reside in their unashamed audacity). The perpetuum mobile may inhabit one of the eight secret chambers of the edifice of nature, but it remains decisive for the floor plan of this chamber that there is an adjoining room. There, in some form, is always Beßler's maid, laboring. If need be, a cavity under the floor will do. Probably the last successful impresario of a perpetual motion machine, John E.W. Keeley, demonstrated a machine in his house in Philadelphia with which he was able to raise a million dollars in start-up capital for the Keeley Motor Company, which was to market a "generator" that extracted the power of water ("There is enough steam

[8] As an aside, here from the entry on „longitude" and the determination of the *longitudo maris*: "Seafarers would have a great benefit if they could determine this with certainty in all places. In this case they could properly register the location, where they are, in the maps of the sea. At this time it is still unknown how such matter is to be investigated" (Eggers, 1757, vol. 2, cols. 6-7).

[9] Perpetuum mobile, die immerwährende Bewegung, le mouvement perpétuel, heißt in der Mechanik, im genauen und eigentlichen Verstande, eine Maschine, welche bloß, vermöge ihrer eigenen Structur, die Bewegung beständig fortsetzet, darein sie einmal gebracht worden, dergestalt, daß solche Bewegung ewig währen würde, wenn die Materie, daraus die Maschine besteht, niemals eingienge, und nichts an ihrer Structur Schaden nähme. Dergleichen Maschine ist wie der Lapis Philosophorum von alten und langen Zeiten her, mit vieler Mühe und Kosten, aber vergebens, gesuchet worden; und viele von den neuesten und gelehrtesten Mathematicis halten es billig, (solange das Reiben oder die Friction der Maschinen, der Widerstand der Luft, und andere Ursachen, die der Bewegung beständig Abbruch thun, nicht gänzlich vermieden werden können), für eine schlechterdings unmögliche Sache, deren Unmöglichkeit sie auch zur Gnüge demonstriret haben. Eine jede Bewegung würde schon für sich ewig dauern, wenn keine äußerliche Ursache dazu käme, die sie nach und nach schwächte, ihren Lauf wandelbar machte, und endlich gar zernichtete.

power in a bucket of water to divert the globe out of its orbit"). After Keeley's death in 1898, one of the financiers bought the house and found a huge compressed air tank under the room with the generator. The *Encyclopaedia Britannica* reports this and ends with the wry remark: "In the course of his long career, Keeley may have broken a number of laws, but the first and second law of thermodynamics, which rule out a perpetual motion machine, he left untouched" (Encyclopaedia Britannica, 1979, p. 105).

CLIMAX AND ANTICLIMAX

At the beginning of the twentieth century, after the perpetuum mobile had disappeared for good even from the speculative gray area on the fringes of technological tinkering, it blossomed again by way of a small late flowering in literature: There was another visionary renaissance of the project in Berlin and a small explosion in Gogulev. In 1910, the publisher Ernst Rowohlt, who was fascinated by this brilliant poet, presented Paul Scheerbart's *The Perpetuum Mobile. History of an Invention* – including 26 construction drawings that had to be incorporated on a folded sheet (Scheerbart, 1910/2011). Scheerbart, the only German author besides Jean Paul whose complete works Gershom Scholem took with him to Palestine (Scholem, 1982, p. 146), made an appearance of excentricity and genius, he was singularly unique in German literature around 1900 and remained so with his thoroughly idiosyncratic mixture of cosmic wit and a radically earnest commitment to life – the earnestness of a man who died of hunger and a broken heart in 1915 in the face of the World War. For him, the perpetuum mobile is a symbol for the universal transformation of the world, but he also wants it to be a reality.

Going through the poet's letters, a selection of which Mechthild Rausch has published in a beautiful edition (Scheerbart, 1990), one can study his proclamations about the "Perpeh," as he likes to write, from May 1908 onwards. I will only give a few extracts here. On "May 15th ... afternoon 4 o'clock 3 min 6 sec" to Richard Dehmel:

> Oh! Hurrah! Finally! At this very moment, oh Riccardo, the patent office in Luisenstrasse has received my wheel '*Gear* wheel moved by weights' – for the time being it exists only in the drawing – but it works – you can be sure of that. Now the new age is coming. What is from now on possible – goes beyond description. All mountains will be 'architecturally' transformed – and the rivers will be channeled into canals. The wheel looks completely different, of course, than it did 4 months ago – and I look different *as well*. Perpetual gear wheel greetings from castle to castle [...] (Scheerbart, 1990, May 15, 1908)[10]

On June 1st again to Dehmel:

[10] „Oh! Hurrah! Endlich! In diesem Augenblick, o Riccardo, hat das Patentamt in der Luisenstrasse mein Rad erhalten 'Durch Gewichte bewegtes *Zahn*rad' - es ist vorläufig nur in der Zeichnung da - aber es geht - davon kannst Du überzeugt sein. Jetzt kommt das neue Zeitalter. Was jetzt alles möglich ist - das ist nicht mehr zu beschreiben. Alle Gebirge werden 'architektonisch' verwandelt - und die Flüsse werden in Kanäle geleitet. Das Rad sieht natürlich ganz anders aus als vor 4 Monaten - ich seh *auch* anders aus. Perpetuirliche Zahnradgrüsse von Burg zu Burg [...]"

> Just submitted a second improved application for the patent. The application costs 20 M – must be paid this week – and I am not *quite* sure – whether I can scrape *this* together. Would you be so kind? The situation is as follows: [a schematic drawing is inserted] The two hatched weights prevent the frictional resistance of the wheel a. That is the redemption!!!!!!!!! For me the matter is *certain* – new cultural epoch herewith *certain*. Hurrah! 7000 trillion greetings from house to house Your *wild* Paulus. (Scheerbart, 1990, June 1, 1908)[11]

And so it goes on. On 9 June in a letter to Erich Mühsam: “Oh Erico! You have probably already heard that I have now actually invented the perpetuum mobile. So naturally I have no time to come into town.” In October to Ernst Rowohlt: “By the way: couldn't you ask your father what effect the total devaluation of coal and automobiles, horse-drawn carriages, etc. would have on the banking world? I believe that all the banks in the world could become insolvent. Am I mistaken? An answer would be very, very important to me! “ In January 1909 to Mühsam: “The perpe is now *working* in my opinion. I have found the 'definitive' solution *after all* and sent it to the patent office the day before yesterday. So get yourself a wallet etc. soon; you will need them. – Me, however, I will become an ascete of the first order – The Sahara will be transformed into an artificial mountain range, and I am with great bear greetings your PCW.” In July 1910, once again to Rowohlt: “From the enclosed final sentence you can see that the problem has been solved definitively. The patent attorney told me that he has *nothing* to object. *One* wheel is enough *now*. It is very astonishing. The mechanic (a simple bicycle repairman) wants to finish the *very* simple model by Friday evening. Then – or Saturday – more.” In September: “Dear Mr. Rowohlt! Am completely intoxicated. The book looks simply delightful. My most sincere thanks.... And in the matter of the model, I have come so far that the world will soon be surprised. Because - and yet it moves!! Nobody believes it yet. [Written in the margin:] But that will soon change. With the most perpetual greetings, your most devoted, Paul Scheerbart.” On November 17, 1911 to Dehmel: “Dear Richard! Herewith the glad tidings that the Perpeh has finally been invented. Unfortunately, I cannot give any more details, as I am no longer alone in this matter. But *this* much is certain: I will soon have *ten* billion. I have therefore become a different person, don‘t drink anymore” – and Scheerbart was a great drinker – “and limit my meals very vigorously. Follow me in this, so that a place is reserved also for you at the table for the saints of my next religion. Hail November eighteenth. Michaelean greetings from house to house! Your pious goose. Now the letter is loose." I will stop here, but not without very seriously recommending Scheerbart's works and letters to all readers; they could start with the novel “The Sea Serpent” (Scheerbart, 1901).

His Perpeh book, his “perpetual” obsession, are at the heart of Scheerbart's utopian aesthetics, which seeks to transform the whole planet in a sensual way – as outlined also

[11] „Habe soeben zweite verbesserte Anmeldung des Patents eingereicht. 20 M kostet die Anmeldung - in dieser Woche muß sie bezahlt werden - und ich weiß nicht *ganz* genau - ob ich *das* zusammenkriege. Würdest Du so lieb sein? Die Sache liegt so: [here a schematic drawing] Die beiden schraffierten Gewichte verhindern den Reibungswiderstand des Rades a. Das ist die Erlösung!!!!!!!!! Mir ist die Sache *sicher* - neue Kulturepoche damit *sicher*. Hurrah! 7000 Trillionen Grüsse von Haus zu Haus Dein *wilder* Paulus."

in his important *Glass Architecture* (Scheerbart, 1972). The perpetuum mobile is the cipher for this will to transformation. The poet, who spent his poetic energy in titles such as “Astral Novelettes [*Astrale Noveletten*],” “Always Courageous! A Fantastic Hippopotamus Novel in Eighty-Three Remarkable Stories [*Immer mutig! Ein phantastischer Nilpferdroman in dreiundachtzig merkwürdigen Geschichten*]” or “Tarub, Baghdad's Famous Cook [*Tarub, Bagdads berühmte Köchin*],” never abandons his visionary innocence; everything could be completely different, and Scheerbart, with unwavering poetic cunning, never completely releases his machine from the realm of the realizable. Once again – but now only in the district of poetic dream-radicality – the perpetuum mobile is to overthrow the course of things in the world. And after all, in the autumn of 1910, the German Colonial and Commercial Bank inquired with Scheerbart about the patent.

And Gogulev? That is the small town in the Russian tundra from Leonid Leonov's most remarkable "Notes of a Small Towner," first published in 1923.[12] Here, during the last years of the Tsarist Empire, unfolds en passant the fate of Dimitri Nikanorovich Terliukov, a brooding inventor. His catastrophe shall be mentioned here because, as if in a grotesque little scientistic nightmare, Leonov once again draws together all the clichés of progress, bizarrely distorted. During a banquet at the mayor's house in Gogulev, the commissioner suddenly spurts out the news:

> „A Perpetun-mobil has been invented, much to my chagrin, by your Dimitri Terliukov!And now he wants to put it into operation publicly ...“ We all screamed. (Leonow, 1962, p. 76)

The demonstration of the machine in Terliukov's garden (with a small celebratory fireworks display) is reluctantly approved by the highly suspicious authorities, and on the appointed day, the educated people of Gogulev come together excitedly. A barrel had been set up in the middle, and on the barrel stood the Perpetun, covered with a raffia mat! There were many ladies present. They sat at the back. In front, however, it was mostly men as the braver sex.”[13] There is a long wait for the inventor, who finally steps out of the house.

> Dimitri Nikanorovich had shaved before the experiment, and his appearance radiated not beauty but a kind of scientific sadness, if there is such a thing in the world. [...] 'Gentlemen!' he began, tearing the mat off his machine, with his finger raised. Everyone listened and saw the machine on the barrel, which resembled a damaged or disjointed grain scythe. 'Before you,' he continued, 'is the latest invention of science. It will undoubtedly soon conquer the whole world and turn everything upside down [...] As its son and friend, I offer it to humankind!' He paused. Everyone sighed deeply, although the sun penetrated their ears, noses and eyes in an unbearable way [...]

[12] The following quotes are translations into English from Hans Ruoff‘s German translation (Leonow, 1962).
[13] This and the following quotes are from the Chapter „How Dimitri Terliukov‘s fame came to naught“ (Leonow, 1962, beginning on p. 78).

The inventor now sums up the history of research ("The Dutchman Thomas Bartholin and others, such as Aristotmen of Hilden, were the first to try fruitlessly to create a Perpetun-mobil"), and finally calls out:

> 'And so two months ago we discovered wherein these wise scholars had erred!' He wiped his forehead with his handkerchief, a dog barked somewhere, the machine stood there like a stone. 'I won't say what the secret is, but I will hint at it. Iron is attracted to the earth incomparably more strongly than copper [...] For, there is significantly more iron ore in the earth than copper. Do you understand?' he asked in a raised voice and closed his eyes as if he were thinking. 'Yes, yes!' it rang out from everywhere, especially from the ladies […] 'As a result of this dominance of iron,' continued Dimitri Nikanorovich, with a trembling hand stroking his Perpetun, 'I managed to invent this device that rotates endlessly. I'll start now. There is no danger at all, just a brilliant fireworks display for the ladies!'

However, at the moment of greatest suspense and to the inventor's deep astonishment, this fireworks display suddenly turns into a kind of bombardment of the party by the otherwise motionless machine ("Terlyukov fell over without saying a word and seemed no longer to be breathing"). The commissioner, whose white uniform had been burned by the machine, cannot be dissuaded from the idea that Terlyukov did all this only "to annoy the government," and thus ensures the dismissal of his old father who had worked as a hospital guard. Thus ends – a melancholic anticlimax – the attempt „to realize that exciting dream of humanity […] so that everyone can eat, drink and be idle, just go for a walk and delight in all kinds of beautiful sights [...]"

SOMETHING FOR NOTHING

"About Orffyreus' gift I have been keeping, / at the same time laughing and weeping" (Lichtenberg, 1983, Nr. 425).[14] Lichtenberg wrote this without further explanation in a short letter to Carl Friedrich Hindenburg dated January 7, 1778, a letter that only served to accompany with three sentences the mailing of his notorious "Fragment of Tails." The brief doggerel verse refers to Orffyeus' treatise on the *Triumphans perpetuum mobile* of 1719 which was evidently brought up by Hindenburg. Lichtenberg responds with these two lines and, indeed, there is nothing more to say about Beßler. Especially a physicist like Lichtenberg can only seriously laugh – or cry – about the human ability to deceive and to deceive ourselves. But commentary, let alone scientific engagement, is uncalled for among Enlightenment contemporaries. This does not mean that the topic had completely disappeared from Lichtenberg's field of vision. As late as 1791 he was still corresponding with his brother Ludwig Christian Lichtenberg about the perpetual motion machine – unfortunately we do not know what was discussed in detail, as we only have notes on the correspondence such as "Written to my brother. about Pe. mob" (Lichtenberg, 1990, Nr. 1836 and 1837). In 1793 and again in 1796 we find in the delightful letters of Georg Heinrich Hollenberg, who was attached and obliged

[14] "Auch ich über Orffyreus Gab' / Zugleich geweint und gelacht hab."

to Lichtenberg, comments such as these: “It is strange! I still have the idea running through my head of inventing the perpetual motion machine, however convinced I am that it is impossible.[…] There is a miller in Osnabrück who has invented such a thing, which is also very nice, and only has the general defect that it does not work like the others, or rather that it works like the others, that is, it stands still” (Lichtenberg, 1992, Nr. 2217). Three years later, there is another letter from Hollenberg, who was evidently constantly tinkering and experimenting. It contains the lovely passage: “I am still pregnant with perpetual motion machines and the like, and this is for me as with ghosts; although I do not believe in them, I always think about them at night” (Lichtenberg, 1992, Nr. 2610). However, he goes on to say: “Yet this time not perpetual motion, but something from Segner's reaction machine” – and then he describes his sober experiments. The perpetual motion machine, which Lichtenberg had associated with exhibits of exotic animals in 1774, is now metaphorically one of the phantoms – a familiar night-time spectre that one likes to talk to. All the more astonishing is what was probably the last appearance of this phantom in Lichtenberg's letters and writings. Here the chimera once again appears in the guise of the drily matter-of-fact and quotidian as it confronts the readers of the Göttingen Pocket Calendar for the year 1797 in a report about a water miller in Livonia. He had constructed his mill in such a way that “it can grind at any time without circumstances or influences, without needing expensive dams, water pressure, etc.” (Lichtenberg, 1797). Lichtenberg begins the short article with a mixture of disdain and ostentatious willingness to examine all new information: “The notorious Orffyre and his perpetuum mobile were long, if not forgotten, certainly no longer considered worthy of respect, when a report appeared in the very esteemed New Nordic Miscellany of Mr. Hupel, in the first volume on p. 508: about a water mill that can grind at any time without being located on a stream or river.” The author of this report, Ludwig August Count Mellin, is praised as the author of “excellent work.” Then comes a detailed description of the device which, however, is currently at a standstill because the iron parts of the machinery did not withstand the pressure of the wooden tubes swelling due to the moisture. “In a word, the man found that iron was not suitable for this, it should have been brass or another metal, and because this requires an outlay of a hundred or more thalers, which the inventor cannot muster, the mill is now, as they say, standing still until he has collected that much money, etc.” Here we encounter the motif of the one small missing cog again, the one comparatively tiny circumstance that is hindering the great work – and an unmistakably sardonic tone creeps into Lichtenberg's diction. At first he appears to be diplomatic: “I carefully refrain from making any judgment about a clockwork that obviously winds itself...” But then, in plain prose: “If one takes all this together, and is familiar with the history of the purely empirical perpetual-motionists, one is almost inclined to believe that this mill was never in full swing, but was only held back a little because of the perfection of the gearwork, perhaps with a little help from the hand or by adding water [...] When their first design fails, these people always have new ones ready to deceive themselves and others. The means of rescuing the design become ever more costly, and it comes to a standstill usually when these are finally beyond their means, and they console themselves with the fact that only their momentary circumstances stand in the way of the greatest and most useful discovery.” It does not really get clearer than

this. When Lichtenberg closes by saying that “the editor of this pocket book should be infinitely pleased” to see his scepticism refuted, his politeness is unassailably correct, but it also sounds unmistakably saturated by satire. In the next volume of the New Nordic Miscellany (1798), Mellin responded point by point to some of the technical questions raised by Lichtenberg, The editor with inscrutable blandness finds these answers “completely satisfactory,” without in any way touching on the fundamentals of the topic. Here we see Lichtenberg keeping an unwavering distance from such projects – but we also see (and this is remarkable) that he refrained from open and categorical controversy until the end of his life.

The phantom of the idea of an inexhaustible source of energy is still with us. Will we never learn to renounce this hope? A late drawing, created in 1961, by the Dutch graphic artist MC Escher shows one of his typical paradoxical architectural puzzles by drawing a stream of water that is channeled by a flat brick pipe through a kind of pavilion, falling from a certain height and yet, as it continues to flow, quietly returning to its starting point, thus driving the wheel of a mill forever (Escher 1971, ill. 76, comp. p. 16) – just as in another famous drawing by this master, the monks of a monastery are constantly walking up the steps in a square. Thanks to the optical trick, the mill wheel now turns forever, in perpetuo, as long as – Escher charmingly adds this in an introductory note – the miller does not forget to occasionally add a bucket of water “to compensate for the evaporation.” Thus Escher first circumvents the constraints of reality with elegant irony and lets the water flow uphill, only to then remind us with malicious correctness that unfortunately there is no stable, closed system.

The wheel in Beßler's sealed chamber runs continuously and to the Landgrave's gracious satisfaction – but only as long as the oath-bound maid does not relent in her hiding place. Does this not remind us from afar of another famous machine that began to excite the imagination about three quarters of a century later? In van Kempelen's chess machine, which Maelzel later improved and demonstrated, there is secretly (as Edgar Allan Poe immediately deduced) a chess-playing dwarf hidden beneath the Turkish figure (Carroll, 1975; Racknitz et al., 1983; Poe, 1984). Walter Benjamin provocatively described this process at the beginning of his theses “On the Concept of History” as an emblem of the relationship between the “puppet that is called 'historical materialism'” and theology – historical materialism always wins when it makes use of the good offices of theology, “which today is known to be shrunken and ugly and is not allowed to show its face anyway” (Benjamin, 1974, p. 691). It would be presumptuous to place the stoic maid and her drudgery as one emblematic figure alongside the world-famous, highly accomplished dwarf in the chess machine as another, but perhaps she does afford a more modest symbolic figuration – she is always „next door,“ presenting the bill to that (relentless?) technological optimism that wants to believe that there is something for nothing, something for free, something from the nothingness of endlessness. All the oaths we make her swear are in vain.

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