

An Investigation of Tambora Hypotheses I & III in Relation to the Invention of the Running Machine in 1817

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Fr Frankenstein and Dracula were a result of the eruption of the Indonesian volcano Tambora in 1815. My paper presents research which indicates that the invention of the bicycle was not, however, a result of this as has been proposed.¹

In the year following the eruption, the ash clouds of the volcano brought extreme bad weather to the northern hemisphere. A group of British tourists, including some with literary ambitions – Mary Shelley, John Polidori and Lord Byron, were staying at Lake Geneva in Switzerland and passed their time indoors during those rainy days by writing horror stories that have become very famous.²

1816 — The Year Without a Summer

The climax of crop failures in the year 1816, and snowfall during the summer, was a climatic catastrophe caused by the volcanic eruption of Tambora on the Sunda Islands, near Bali, in 1815,¹⁵ where 50,000 inhabitants had been killed. The dust created moved to the northern hemisphere, causing permanent bad weather. Even the New England states of America were hit, and people froze to death. The United Kingdom hastily bought corn from the United States, and the German countries from Russia. In 1817,¹⁶ a newspaper in Mannheim, which had a Rhine harbour,

wrote that "by the present universal corn shortage, the usual and natural transport links are totally disrupted and a regular circulation of corn supplies to the interior of the country is not possible because so many horses have been slaughtered because of the scarcity of fodder". Yet the bar in Playfair's diagram for 1816–20 is already lower since the good harvests of 1817, 1818, 1819, and 1820 counterbalanced the peak corn price for 1816. This exceptional situation fueled Drais' experiments once more, with the two-wheeler as the result. Yet the return of the horse economy after the first good harvest of summer 1817 also caused the decline of the human-powered velocipede, as a result of bans and fines by the authorities.

Figure 1. Detail from *Cycle History 11: The Proceedings of the 11th International Cycling History Conference* (Cycle Publishing, San Francisco) (2000), p32/33: The underlined words are not to be found in the mentioned source - *Mannheimer Intelligenzblatt* of 24 June 1817. Also, the assertion that people froze to death in New England in the US is not confirmed.

The genesis of the bicycle and its precursor – the running machine - as a supposed result of the volcanic eruption (Hypothesis I) is a hypothesis but not a fact. It was first presented at the 11th International Cycling History Conference³ (11th ICHC) in Osaka/Japan in the year 2000. The paper's author, Hans-Erhard Lessing, has since continued to promote this hypothesis with some adjustments (Hypothesis

"II). My paper will review the attempts previously presented to support the Hypotheses I and II, and there will be also presented new evidence which challenges these hypotheses. Finally, I will present the results of my research that indicates the ideas for the running machine came to Karl von Drais from his understanding of ice skating.

An incorrect quotation

After my unyielding research it is confirmed since 2015 that the quotation used to support the Hypothesis I was not found in the cited source or elsewhere. The quotation was cited as being from the newspaper *Mannheimer Intelligenzblatt* of 24 June 1817 [Figure 1] It was given as, "many horses have been slaughtered because of the scarcity of fodder". In a hand written postcard from 14 April 2015 the author has called this quotation

Mannheimer Intelligenzblatt, No. 50. Dienſtag den 24ten Juni 1817.

Bekanntmachungen.

(Den Verkauf der Früchte und die Bestimmung des Preises betr.)

In Ermüdung, daß durch die allwärts eingetretene Getraideſperre die gewohnten und natürlichen Verkehrsverbindungen gänzlich zerſtört ſind, und nicht zu erwarten ſteht, daß ſich unter den gegenwärtigen Verhältniſſen eine regelmäßige Circulation des vorräthigen Getraides im Innern des Landes bilde, vorzüglich auch in der weitern Betrachtung, daß nach und nach die Zahl der Verkäufer, die einen bedeutenden Ueberschuß beſitzen, ſich immer mehr mindert, und daher um ſo eher ein wucherliches Zurückhalten der Vorräthe und eine Steigerung der Preise durch künstliche Mittel zu befürchten iſt; wird der Einkauf und Verkauf des Getraides unter folgenden nähern Beſtimmungen der öffentlichen Auſſicht, Anordnung und Leitung unterworfen.

English Translation:

Notifications

(Concerning corn sales and regulated prices)

Considering that export bans for corn have been enacted everywhere so that the natural trading customs and systems have been totally disrupted, and as it is therefore expected that regular corn supplies will not be available in the interior of the country ---- corn trade will be regulated to avoid an anticipated usurious withholding of supplies and an artificial rising of prices.

Etymologisches Wörterbuch des Deutschen / Zentralinstitut für Sprachwissenschaft, Berlin © 1993 Akademie Verlag GmbH 1504

Verkehr m. 'Handelsverkehr, Umsatz, Vertrieb von Waren' (1. Hälfte 18. Jh.), danach '(gesellschaftlicher) Umgang, Verbindung, Gemeinschaft mit jmdm.' (2. Hälfte 18. Jh.), 'das Hinundhergehen und -fahren in der Öffentlichkeit, Beförderung bzw. Bewegung von Personen, Fahrzeugen, Gütern, Nachrichten auf dafür vorgesehenen Wegen' (2. Hälfte 19. Jh.).

Etymological Dictionary of the German Language Berlin (1993)

Verkehr: trade (1st half 18th century), then social relations (2nd half 18th century) movement of persons and goods, traffic of vehicles (2nd half 19th century)

Figure 2. An announcement in the *Mannheimer Intelligenzblatt* that had been totally misinterpreted in *Cycle History 11*, p. 32-33. The transport links were not disrupted as supposed. Instead it should read "trade links". They were disrupted because of export bans for corn everywhere to stop border crossing speculation. The German word *Verkehr* formerly did not mean traffic or transport transport: it meant trade - see excerpt from the *Etymological Dictionary* in this Figure.

a fake.⁴ Subsequent to this, the words of the quotation in dispute were found to still be in use to support the hypothesis, but now without quotation marks⁵ and without any source.⁴ Conclusion: This statement should not be relied on as evidence for Hypothesis I.

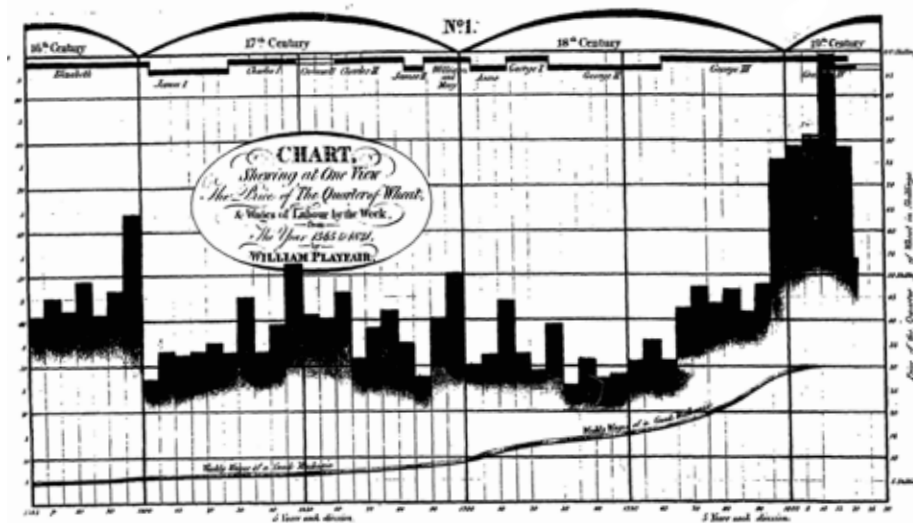
The Tambora Hypothesis I incorrectly makes the connection between the Tambora volcano and an impact on traffic! The origin of this connection was a misinterpretation of the German word Verkehr⁶ nowadays meaning traffic in general, but formerly meaning only trade. In an announcement of the mentioned

newspaper from 1817 [Figure 2], there were reported disrupted trade connections because of export bans everywhere for corn (grain) that were meant to stop border crossing speculation. The Tambora Hypothesis I misinterprets the disrupted ‘trade’ connections as disrupted ‘transport’ connections and even assumed for “1816...in Europe” a “breakdown of traffic”.⁷

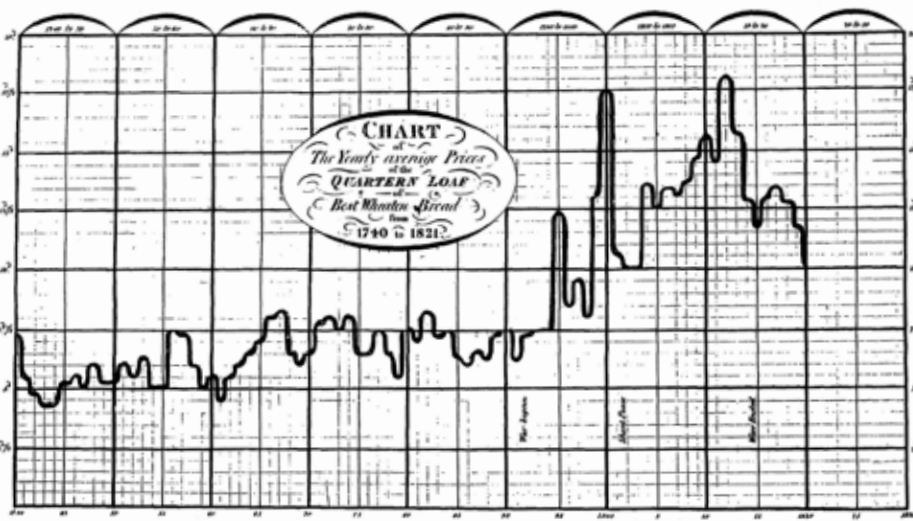
As an explanation, there was thought to be a lack of horses – as reason for that, there was thought to be a great number of horse deaths in Mannheim in 1817.⁸ It was speculated that these deaths were

caused by this chain of events – the volcanic ash clouds, bad weather, bad crops, and finally, a scarcity of fodder. The conclusion then was that an absence of horses should have inspired Karl von Drais to invent the running machine as a substitute for them, although this said absence of horses has never been proved.

The American author Gillen D’Arcy Wood took this conclusion, which had been presented as fact, at face value. Therefore he wrote erroneously of a “decimation of Europe’s preindustrial transport system” and also of an allegedly resulting genesis of the running machine in his book *Tambora*, published in 2014.⁹ In his epilogue, he referred explicitly to the paper in the 11th ICHC. Then, in a chain reaction, some German newspapers¹⁰ also adapted this story without any proof for their articles that celebrated the 200th anniversary of the eruption of the Tambora volcano. There was no attempt to correct this fundamental error suggesting that Lessing’s incorrect interpretation of information about the Tambora eruption and its role in the invention of the ‘running machine’ by Drais was very welcome at these newspapers.



Playfair I (1822), p39: Chart, showing at One View the Price of Wheat & Wages of Labour by the Week 1565 - 1821. - 5 years each division - Peak in division 1810 - 1815



Playfair II (1822), p35: Chart of the Yearly average Prices of the Quatern Loaf of best Wheat Bread from 1740 - 1821. Peak in the year 1800 & 1812/13

Figure 3. The peak prices for wheat and wheaten bread in England did not correspond to the year of the invention of the running machine, 1817, as referenced in all the publications for Lessing’s Tambora Hypotheses.

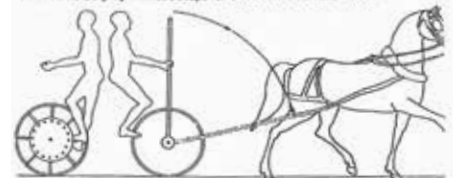
**Fahrmaschine in:
Badisches Magazin, 22. Dezember 1813**

“A carriage without horses driven by one in sitting person, invented by Baron von Drais”

**Technische Erfindung
und Ehren-Auszeichnung.**

Der Kammerjunfer und Hofschreiber v. Drais hat seinen erfundenen Wagen, der ohne Pferde durch den lühenden Menschen getrieben, leicht und schnell hinkommt – wie schon vorher unserer Landesherrenschaft – so jetzt Ihrer Majestät dem Kaiser von Russland vorgeführt. Der Monarch hatte daran Wohlgefallen, verlangte am folgenden Tage die nochmalige Vorzeigung; äußerte «c'est bien ingenieux» und sandte dem Erfinder einen brillantenen Ring „für das Vergnügen, welches „Ihrer Kaiserl. Majestät damit gemacht worden sey.“

What a horse-play: 16 little steps for one rotation of the wheel



Reconstruction by H.-E. Lessing in 'Automobilität'/p 117, here 2 persons, in the historical text only ONE single person!

Figure 4. An impossible human-powered vehicle presented as possibly the idea of Karl von Drais. Each tread would have moved the machine less distance than one normal step.



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The average temperature during the last 16 years was in Karlsruhe; (in degrees Réaumur)

Die mittlere Wärme in den letzten 16 Jahren war zu Karlsruhe:

1800 == 8, $\frac{3}{10}$ Grad.	1808 == 7, $\frac{8}{10}$ Grad.
1801 == 9, $\frac{2}{10}$ —	1809 == 8, 0 —
1802 == 8, $\frac{7}{10}$ —	1810 == 7, $\frac{7}{10}$ —
1803 == 7, $\frac{7}{10}$ —	1811 == 9, $\frac{7}{10}$ —
1804 == 8, 0 —	1812 == 7, $\frac{7}{10}$ —
1805 == 7, $\frac{7}{10}$ —	1813 == 8, $\frac{7}{10}$ —
1806 == 9, $\frac{7}{10}$ —	1814 == 7, $\frac{7}{10}$ —
1807 == 8, $\frac{7}{10}$ —	1815 == 8, $\frac{7}{10}$ —
	1816 == 8, $\frac{7}{10}$ Grad.

(Jan.-Dec./p.300-313)

8,5°Réaumur=10,63°Celsius=51,13°Fahrenheit

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Water-columns from rain and snow: die Höhe des gefallenen Wassers:

1801 == 33 Zoll 8 Lin.	1809 == 25 Zoll 5 Lin.
1802 == 24 — 0 —	1810 == 26 — 0 —
1803 == 28 — 0 —	1811 == 21 — 6 —
1804 == 30 — 1 —	1812 == 21 — 0 —
1805 == 28 — 7 —	1813 == 25 — 1 —
1806 == 26 — 6 —	1814 == 19 — 2 $\frac{1}{2}$ —
1807 == 26 — 0 —	1815 == 19 — 4 —
1808 == 70 — 0 —	1816 == 31 — 0 $\frac{1}{2}$ —

Mittelwert average } 28,54 Zoll = 856,2 mm

(1 badischer Zoll = 10 Linien = 30 mm)

(≈ 1 $\frac{3}{16}$ inch)

Ettlingen had 74 days with frost in 1816; but there were none during the five months from May till September (contrary to the New England States in America).

hatten 74 Tage, an denen es frost; am meisten im Februar, November, Dezember und Januar; auffreiem nur im März, April und Oktober.

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Weather-survey of Ettlingen, a town in the Rhine-valley near Karlsruhe - the capital of the Grand Duchy of Baden

Jahr year	Ganz hellere Tage.	Ganz trübe Tage.	Mittl. Tag.	Regen Tage.	Schne. Tage.	Schlo. den.	Gewit. rrr.	Stürm. me.	Wetel.
1801	58	72	235	143	24	6	21	13	7
1802	90	68	207	105	23	6	16	10	8
1803	58	71	236	101	21	6	20	15	6
1804	34	60	272	147	27	6	18	8	10
1805	46	64	235	127	29	7	17	11	4
1806	33	90	242	162	17	3	14	25	15
1807	42	87	236	101	41	2	21	13	6
1808	36	89	241	125	32	5	20	17	7
1809	27	66	272	129	26	4	19	11	2
1810	29	72	264	136	14	5	13	14	6
1811	51	51	263	124	24	7	22	2	0
1812	25	71	269	125	24	12	17	3	12
1813	16	59	290	129	15	9	26	13	9
1814	44	60	261	127	22	4	21	5	2
1815	32	61	272	137	21	14	19	21	2
1816	17	67	282	172	31	13	13	22	10

Witterung	1801	1816	middle 1801 to 1816
complete sunny days	42	70	7
complete overcast days	253	128	12
mixed days	24	6	19
rainy days	128	24	12
snow days	24	6	19
days with hail	6	19	12
thunderstorms	19	12	7
hurricanes	12	7	10
days with fog	7	10	18

The rainy days exceed 1816 the range of the other years. They are +35% over average. In second position 1806 with +27%. The complete sunny days are 1816 -60% (like 1813), the days with hail are +117% and the hurricanes are +83%. The mixed days with sun and clouds are +11%, but these made three quarters of the year.

Figure 5. The climate in the upper Rhine-valley at the beginning of the 19th century.

Pleadings without a cause

All the papers presenting the Tambora hypothesis contain a chart by William Playfair from 1822 showing wheat prices in England from 1565 up to 1821 divided in 5-year periods of time.¹¹ This chart has been used to make the claim that the absolute peak would have been in 1817 – the year of the invention of the running machine [Figure 3]. A closer examination of the chart reveals that the highest peaks were in 1800 and 1812/13, as shown in a second chart by Playfair, based on yearly prices.

This misinterpretation of Playfair’s chart with the 5-year-columns has been supplemented with an enigmatic reconstruction of Karl von Drais’ four-wheeled *fahrmaschine* from 1813 (and additionally with a drawing of the running machine) [Figure 4]. In spite of an historic report in *Badisches Magazin*¹² saying the machine was driven by only one person in a sitting position, the illustration presented two persons; one for driving and one for steering. The driving

person looking backwards had to tread on rungs fixed around the rear axle to turn it, together with the wheels; 16 rungs meant 16 treads or eight double-treads for one rotation of the wheels. In the case of a wheel with a 1 meter diameter, one turn of the wheel advances the rider only 3.14 meters; or one double-tread would have given way to less than 0.4 meters. Even bigger wheels would not have solved the problem of inefficiency. In a letter from February 2016, I told the author that Karl von Drais would not have been such a fool to do so and that this reconstruction would do him an injustice. We know that the inventor from the very beginning preferred his revolutionary double cranked rear axle to be trodden directly; as he later disclosed his secret was to have one double-tread for one rotation of the wheels.¹³

Data on the climatic situation in Ettlingen, near the Badenian capital Karlsruhe, from 1800-1816 is shown in Figure 5.¹⁴ There really had been much bad weather since 1816 as a result of the Tambora

ash clouds and there really had been a reduction of the crop. But the situation in the upper Rhine valley was better than elsewhere. In the Grand Duchy of Baden, the crop was reduced in 1816 only by 16 per cent.¹⁵ And there was still much horse activity in town [Figure 6], as reported in the *Mannheimer Intelligenzblatt* during Spring of 1817. The Tambora Hypothesis I, however, uses reports about dead horses from far away and from poor regions, like the Black Forest, the Swabian Alb, and even from France. The situation in France was a special one after the definitive defeat of Napoleon in 1815, with subsequent political riots, problems of supply, and the occupation by British, Russian, and Prussian troops that contributed significantly to the shortage of horses in this area.

The German historian and expert on the history of climate, Prof. Dr. Wolfgang Behringer, declared, “it would be rather impudent” to construct a causality between the Tambora weather and Karl von Drais’ invention of the two-wheeler.¹⁶

Tambora Hypothesis I is refuted by Tambora Hypothesis II

The initial Tambora Hypothesis I has now been replaced by Tambora Hypothesis II. Hypothesis II claims that the birth of the running machine was not a result of an existing lack of horses, but rather of an imminent lack of horses. This appears on p. 51 in the catalogue of the bicycle exhibition at the Technoseum in Mannheim, 2016/17.¹⁷

This Tambora Hypothesis II refers to the description by Karl von Drais of his four-wheeled carriage without horses¹⁸ published in early January 2014. In it he still kept secret the foot-driven mechanics of its rear axle, which led to some confusion then and nowadays.¹⁹ Further, in a great promotional effort he presented an extensive collection of advantages of his carriage. The first one was the absence of any clockwork, which avoided the waste of time for preparation and even the risk of a technical breakdown. There were at least ten advantages, such as the economy compared with that of a horse. The absence of the latter (i.e., a horse) should avoid the problems of indisposition, laziness, frightening, and accidents; it would especially avoid whirling up dust, it would give a free look-out in front, and it would enable an opportunity to take out a lady or two for a pleasant drive.

Besides some additional equipment, like a covering or a luggage locker, the inventor recommended his machine for taxi services, for the delivery of letters, or as substitute for the wheel-barrow. And then under advantage number seven, he saw a chance to sell it to the military. He wrote: "In wartime, when horses and their fodder often become scarce, a small fleet of such carriages at each corner could be important."²⁰

A false reasoning

The Tambora Hypothesis II uses a hint from an imminent requirement to have

Figure 7. The German national coin honoring the 200th anniversary of the running machine in 2017 shows a sportsman astride the invention, behind his shoulder a smoking volcano from far away and below that a tiny coach without relay symbolizing a supposed lack of horses. These inclusion of the volcano and coach without relay are based on the disputed Tambora hypothesis.

Mannheimer Intelligenzblatt

25 February 1817
Long distance coach to Munich
 21 March 1817
Daily regional coaches & long distance coach to Munich
 13 & 16 May 1817
Castrating of stallions
 21 March 1817
Two competitions for delivering corn and fodder to the military
 6 May 1817
Increasing cost of the fodder raises fee for horse-drawn wood-transport by 17%

9 May 1817
Kaufgelegenheit.
Daily regional coaches & long distance coach to Munich

16 May 1817
Riding on the sideways in the castle's garden prohibited

Versteigerungen.
 1) Mannheim. (Versteigerung, Versteigerung.) Der Darg der Drais- und Drais'sche Pferde des Drägeners Regiments von Herrn Dr. R. I. wird auf weitere 6 Monate, nämlich vom 1ten Juli bis 31ten December d. J. und zwar in Schätzungen: von ungefähr 150 Pferde, Donnerstag den 12ten d. Monats, um 9 Uhr im Pflanzhof; und in Mannheim von ungefähr 300 Pferde, Freitag den 13ten dieses in der Pflanzhof'schen Kaserne an die Weisenden öffentlich versteigert. Mannheim den 2ten Juni 1817.
 Das Kommando des Drägeners Regiments von Grafen Dr. I.
Two auctions of the dung of 450 military horses

6 June 1817
Supply of a Russian dragoon regiment on its way home from France

26 August 1817
Coaches to regional destinations & long distance coach to Frankfurt

Figure 6. A selection of horse related news during the spring and summer of 1817 in the Mannheimer Intelligenzblatt. The long distance coaches especially needed a lot of horses at the relay stations on their way. Noteworthy: Having dung from 450 military horses for sale indicates that there must have been enough fodder for producing this material at this time.



inspired the invention of the running machine more than three years later. But that overstretches the intention of the inventor who had only published a marketing concept. And above all, an imminent, or supposedly imminent, requirement is not a guarantee for an invention, especially for such a revolutionary idea like a one-track-vehicle! Therefore, the Tambora Hypothesis II, in my eyes, is based on incorrect reasoning.

When Karl von Drais developed his running machine there was already the prospect of a good crop. The *Mannheimer Intelligenzblatt* from 3 June 1817 announced that there was enough grain in stock for the supply of the inhabitants with bread until the new crop was harvested. Even the supply of horses was secure. The already new and tasty grass and clover caused some nervous fever among horses when they were surfeited – as reported by Georg Friederich Tscheulin, veterinarian at the Badenian court.²¹ He declared, “I had to care for over 100 horses” beginning in May and June 1817, and “not more than a one has died”. That means the disease (hunger) was not as lethal as supposed. Then he mentioned the death of several horses elsewhere as the work of bunglers and charlatans. The decisive fact, however, is that at this time the running machine was already in construction, in test, and finally on its way. Therefore the disease came too late for Tambora Hypothesis I or II.

At last, even the supposed lack of horses as a result of the eruption of Tambora is refuted. A paper claimed without evidence that, “horses starved to death or were slaughtered before they starved...

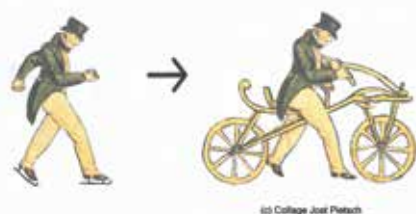


Figure 8. Karl von Drais and his idea for the running machine: The principle of gliding on ice with the benefit of its momentum should be imitable to solid ground by means of an apparatus rolling on wheels. With two wheels in line and steering, he discovered – what a surprise – the miracle of balancing. Collage based on a painting by Joseph Paul Karg in 1819, showing Karl von Drais.

Horseless transport was now definitely a *desideratum*”.²² Actually, the running machine was never thought to fulfill horseless transport. Another article stated, “obviously there were no draught horses at hand any more”.²³ Also, “there were no horses left”.²⁴ A schedule of the number of horses in Germany between 1800 and 1816 by Eberhard Bittermann²⁵ shows a reduction in the horse population at this time of only 13 per cent. This is an astonishing small number, and, as alluded to above, the reason for this reduction in the number of horses lies in the Napoleonic wars of that epoch.

An article in *New Scientist*²⁶ depending on only a single source, also links Karl von Drais’ invention to the eruption of Tambora. However, the statements made in this article (relating the expectation of falling prices for oats and hay published several months after the birth of the running machine with a supposed influence of the Tambora volcano eruption from the time before it was invented) is not rational.

A national coin to commemorate the 200th Anniversary of the Running Machine

A German national 20-Euro coin in silver honoring the invention of the running machine [Figure 7] shows a rider in action on this machine and in the background a smoking volcano, plus a tiny coach without relay to symbolize a supposed lack of horses. Sadly, the Tambora Hypothesis has become the

FAIRBURN'S WHIMSICAL DESCRIPTION OF THE NEW PEDESTRIAN CARRIAGE, OR, Dandy Hobby-Horse.

The following account of the Machine is given by the inventor, Baron Charles de Drais, master of the woods and forests of H. R. H. the Grand Duke of Baden.

1. That on a well-maintained post road, it will travel up hill as fast as an active man can walk.
2. On a plain, even after a heavy rain, it will go six or seven miles an hour, which is as swift as a courier.
3. When roads are dry and firm, it runs on a plain at the rate of eight or nine miles an hour, which is equal to a horse's gallop.
4. On a descent, it equals a horse at full speed.

Its theory is founded on the application of a wheel to the action of a man in walking. With respect to the economy of power, this invention may be compared to that very ancient one of carriages. As a horse draws, in a well-constructed carriage, both the carriage and its load much easier than he could carry the load alone on his back; so a man conducts, by means of the Accelerator, his body easier than if he had its whole weight to support on his feet. It is equally incontestible, that the Accelerator, as it makes but one impression, or rut, may always be directed on the best part of a road. On a hard road, the rapidity of the Accelerator resembles that of an expert skater; as the principles of the two motions are the same. In truth, it runs a considerable distance while the rider is inactive, and with the same rapidity as when his feet are in motion.

Courtesy of Roger Street

Figure 9. An English translation of Karl von Drais’ explanation of how his running machine and its principle was taken from skating. From Fairburn’s *Whimsical Description of the New Pedestrian Carriage or Dandy Hobby-Horse*, London, UK, 1819. Colored caricature pamphlet, as found in the Port Elizabeth, South Africa Public Library collection, 16pp., circa 1818. (Courtesy of Roger Street)

basis for the design of that coin even though the evidence for the hypothesis behind the story is weak. It is important to know that the promoter of the Tambora Hypothesis was the historical adviser and a member of the jury, which had decided the design contest of the coin. It could be understood as a creation of a so-called alternative reality.

A great deficiency of the Tambora Hypotheses I and II is that they do not present any research about the technical idea and its development to create the running machine.

Karl von Drais and his "Eureka!" on ice

Karl von Drais' special story begins in winter not later than early in the year 1817. We have found a reference given by von Drais himself which – as it seems – has been previously overlooked. In this paper Drais declares that his idea for the running machine came from skating.²⁷ And in his description of his invention published in November 1817, he repeats it with some surprising details: "On a hard road, the rapidity of the Accelerator resembles that of an expert skater; as the principles of the two motions are the same. In truth, it runs a considerable distance while the rider is inactive, and with the same rapidity as when his feet are in motion."²⁸ This last sentence is a most important reference to the momentum that can be achieved with his machine as can also be done when skating!

This means that Karl von Drais had his "Eureka!" on ice and his inventive idea was to transfer it to overland travel. The easy preservation of the momentum by gliding on ice should be imitable by means of an apparatus rolling on wheels over solid ground. It turned out that a slender frame on two wheels, where the wheel in front can be steered, and a seat in between would work best to do the skate-like propulsion and also to use the power saving benefit of the momentum. It offers the comfort of sitting while kick-stepping the machine, which gives an additional benefit by unburdening the legs from the weight of the body, so that they may use their whole force exclusively for the movement. Both ideas save energy. The principle that a weight is more easily transported on wheels than to be carried by an animal was already used by Karl von Drais in his four-wheeled human powered vehicle of 1813 called the *fahrmachine*.

Momentum and the miracle of balance

The miracle of balancing the running machine was an inconceivable phenomenon in spite of some experience from skating. The ability to balance when riding on two wheels in line was a reward for the courage to build such a whimsical slim wooden machine, and it was an experimental discovery made during tests on steering the machine. Adding the balance board (i.e. an arm rest) to facilitate the managing of the machine was also a result of these tests.

Skating is a good exercise for learn-

ing how to balance, but it is transient, as it is alternating from one leg to the other. Therefore, the one-legged skater is the true master of balance, or the normal skater when one leg is lifted. The similarity with the two-wheeler is only fulfilled when the skater puts his skates in line one after the other. With a little bit of twisting one leg against the other he can even manage the steering. In any case, balancing on skates, or on two in-line wheels, requires momentum.

Summary and Conclusion

The running machine is an amalgamation of the principle of the *fahrmachine*, as self-transport and the principle of skating – supported by the momentum and especially by the surprising help of balancing. It combines the ability of propulsion and balancing with the comfort and energy-saving benefit of sitting. The easy handling to keep this apparatus upright by means of its steering against the direction of an imminent falling makes each rider an equilibrist, a privilege limited before to rope-dancers. An explanation of why Karl von Drais never put cranks on the front wheel of his new invention (even though he had formerly been a pioneer in the use of cranks) could be that he saw it as a vehicle simply for 'skating over land'.

No horse had to inspire the idea of a running machine – not even a dead one. Nor was an eruption of a volcano necessary to cause Karl von Drais to invent his two-wheeler which came to be called the Draisine. It is clear that Karl von Drais' inspiration for the invention of this history changing machine was "ice skating". ●

Endnotes

- 1 Hans-Erhard Lessing, "What Led to the Invention of the Early Bicycle?", *Cycle History 11: Proceedings of the 11th International Cycling History Conference*, Osaka/Japan 2000, San Francisco: Van der Plas Publications, 2001, p. 32-33.
- 2 Gillen D'Arcy Wood *Tambora: The Eruption That Changed the World*, Princeton: Princeton University Press, 2014, p. 45 & 52-53
- 3 Hans-Erhard Lessing, "What Led to the Invention of the Early Bicycle?", *Cycle History 11: Proceedings of the 11th International Cycling History Conference*, Osaka/Japan 2000, San Francisco: Van der Plas Publications, 2001, p. 32-33.
- 4 Personal communication from Prof. Dr. H.-E. Lessing on 14 April 2015.
- 5 *The Boneshaker*, No. 198, Summer 2015, p. 7.
- 6 *Etymologisches Woerterbuch des Deutschen*, Berlin, 1993, column 1504, Verkehr (Trade).
- 7 *Cycle History 11*, p. 30, below Playfair's chart.
- 8 Tony Hadland & Hans-Erhard Lessing, *Bicycle Design*, Cambridge: The MIT Press, 2014, p. 10.

⁹ Wood, *Tambora*, Epilogue, p. 229.

¹⁰ *Die Zeit*, No. 12, 19 March 2015, p. 21; *Der Spiegel*, No. 15, 4 April 2015, p. 116,117; *Faz*, No. 80, 7 April 2015, p. 9.

¹¹ William Playfair, *A Letter on our Agricultural Distresses, Their Causes and Remedies: Accompanied with Tables and Copper-plate Charts, Shewing and Comparing the Prices of Wheat, Bread and Labour, From 1565 to 1821. Addressed to the Lords and Commons*, London: Printed for W. Sams, 3rd Edition, 1822, p35 & 39; presented e.g. in *Cycle History 11: Proceedings of the 11th International Cycling History Conference*, p. 30; *Cycle History 22: Proceedings of the 22nd International Cycling History Conference*, p. 183; *Bicycle Design*, p. 9.

¹² *Badisches Magazin*, Volume 3, 22 December 1813.

¹³ *Badisches Magazin*, Volume 4, 5 January 1814, explanation by Karl von Drais about his newly invented four-wheeled *fahrmachine*, quoted in *Mannheimer Geschichtsblaetter* No. 11/12, November/December 1933, column 170-175; There he still made a secret about his foot-driven mechanics of the rear axle. But later he repeated the same text with the one difference, where he disclosed his secret: The (double) cranked rear axle to be trodden on directly. Published in *Neues Magazin aller Neuen Erfindungen, Entdeckungen und Verbesserungen*, (New Magazin of all New Inventions, Discoveries and Improvements), Leipzig, 1816.

¹⁴ Peter J. Schneider, *Topographie von Ettlingen*, Karlsruhe: 1818 - Reprint 1993, p. 300-316.

¹⁵ Württembergisches Landesmuseum Stuttgart, *Baden und Wuerttemberg im Zeitalter Napoleons* (Baden & Wuerttemberg at the Time of Napoleon), Catalogue 1.1 of the exhibition, Stuttgart: 1987, p. 477.

¹⁶ *DER SPIEGEL* No. 10, 4 March 2017, p. 98.

¹⁷ Eva Maria Gramlich, Yvonne Maier and Thomas Kosche (eds.), *2 Rader – 200 Jahre Freiherr von Drais und die Geschichte des Fahrrades (2 Wheels – 200 Years Baron von Drais and the History of the Bicycle)*, Mannheim: Theiss Verlag, 2016.

¹⁸ *Badisches Magazin*, Volume 4.

¹⁹ Eva Maria Gramlich, Yvonne Maier and Thomas Kosche (eds.), p. 45.

²⁰ *Badisches Magazin*, Volume 4.

²¹ Georg Friederich Tschulin, *Beschreibung und Heilung des Nervenfiebers welches im Fruhjahr und Sommer 1817 unter den Pferden hier und in der Gegend geherrscht hat*, (Description and healing of the nervous fever which has raged among the horses in Spring and Summer 1817 here and in this region), Karlsruhe: 1819, pp. 9 & 16.

²² Hans-Erhard Lessing, *The Two-Wheeled Velocipede: A Solution to the Tambora Freeze of 1816*, *Cycle History 22: Proceedings of the 22nd International Cycling History Conference*, Paris 2011, San Francisco: Van der Plas Publications, 2012, p. 182.

²³ *The Boneshaker*, No. 198, p. 8.

²⁴ Tony Hadland and Hans-Erhard Lessing, *Bicycle Design: An Illustrated History*, Cambridge: MIT Press, 2014, p. 10.

²⁵ Eberhard Bittermann, *Die landwirtschaftliche Produktion in Deutschland 1800-1950: Ein methodischer Beitrag zur Ermittlung der Veränderungen des Umfanges der landwirtschaftlichen Produktion und der Ertragssteigerung in den letzten 150 Jahren*, (Agricultural production in Germany 1800:1950: A methodological contribution to the determination of changes in the scale of agricultural production and the increase in yields over the last 150 years), Wittenberg: Niemeyer, 1956; Schedule reprinted in *A Carriage that goes without Horses*, *Cycling History* No. 8, 2017 (Veteran-Cycle Club, UK), p. 23.

²⁶ Mick Hamer, "Brimstone and Bicycles" in the *New Scientist* of 29 January 2005, p. 48-49.

²⁷ *Badwochenblatt*, 29 July 1817, p. 189.

²⁸ *Die Laufmaschine des Freiherrn Karl von Drais*, Mannheim, 1817, translated in Fairburn's *Whimsical Description of the New Pedestrian Carriage or Dandy Hobby-Horse*, London, 1819.