

“Unattainable” Has Four Senses in This Corpus, and Two of Them Sit in One Field

— Repeated adiabatic demagnetisation takes the temperature $1 \rightarrow 10^{-2} \rightarrow 10^{-4} \rightarrow \dots$, a factor of **0.010000** at every step, so with the ratio unchanging no finite number of steps reaches **0** — unattainability is not a prohibition but a consequence of the entropy difference vanishing as $T \rightarrow 0$ — [Paper 509]

Yuuki YAMAGISHI (山岸 勇輝)
Yamagishi Complexity Torus Lab, Japan
September 2026

— *From thinking to syncing.* —

Abstract

The unattainability of absolute zero is taken to be a prohibition. This paper shows that it follows from how the entropy difference vanishes—swap in a model where it does not vanish and **0** is reached in **1** step. No new theorem or law is claimed. First, repeated adiabatic demagnetisation lowers the temperature by a factor of **0.010000** each step (Section 2). Second, the ratio is the same at all six steps, never moving from **0.010000**—being geometric, no finite number of steps reaches **0** (Section 2). Third, the steps required scale with the logarithm of the target—**1.50** steps to 10^{-3} and three times that, **4.50**, to 10^{-9} (Section 2). Fourth, this is the core of the paper. A model violating the third law reaches **0** at step **1** (Section 3). Fifth, the same word “unattainable” already carries three other senses in this corpus (Section 4). Sixth, the separator is whether it is a prohibition or a rate of approach (Section 4). **Keywords:** unattainability, third law of thermodynamics, Nernst heat theorem, absolute zero, polysemy.

Scope of this paper (scope note): No new theorem or law is claimed—Nernst’s heat theorem, the unattainability of absolute zero and the relation between them are all standard. Thermodynamics is not founded—which axioms yield the third law, and its relation to quantum statistics, are not the subject. The model is not a real substance— $S = (T/(T + b))^\alpha$ carries only the behaviour of the entropy as $T \rightarrow 0$; it is not the measured behaviour of a paramagnetic salt. Finite time is excluded—how long a step takes, and the limits of experiment, are not the subject; only the number of steps. No claim that four is the whole count—the three earlier senses were read and confirmed, but it is not shown that no others exist. Relation to earlier papers: Paper 126 showed that the existence of an integrating factor does not give a temperature, treating Carathéodory’s adiabatic inaccessibility—that “unattainable” and this one are distinct roots. Paper 403 showed that the order of temperature is not the order of hotness—both are cases of another quantity hiding under the word “temperature”. Paper 300 showed that a shared root can be decided—one word carrying at least four distinct roots. Paper 481 showed that without separators a refutation has no destination—this paper writes one of them. What is added is measuring the per-step ratio as 0.010000, confirming the logarithmic scaling at 1.50 and 4.50, showing that violating the third law reaches 0 in one step, reading the three earlier senses and confirming them distinct, and placing the separator at prohibition versus rate.

1. Notation and the Question

Setting: Write $S(T, b)$ for the entropy at magnetic field b . Adiabatic demagnetisation has two stages: raise the field isothermally, lowering the entropy, then remove it adiabatically. The second stage holds S fixed, so the temperature falls. Take the model

$$S(T, b) = \left(\frac{T}{T + b} \right)^\alpha$$

which sends $S \rightarrow 0$ as $T \rightarrow 0$ for every b , so the curves meet there. Below, $\alpha = 3.0$, b alternating between 10.0 and 0.1, starting from $T = 1$.

Observation 1.1

The unattainability of absolute zero is taken to be a prohibition. The third law forbids it—a picture of a wall.

Observation 1.2

But if there were a wall, the resistance should change on approach. Each step buying less—what actually happens can be measured.

Question: How many steps, and how far down.

2. Each Step Divides by the Same Factor

Computation 2.1: Repeat the cycle six times.

Step	Temperature	Ratio to the previous
1	$1.000000000 \times 10^{-2}$	0.010000
2	$1.000000000 \times 10^{-4}$	0.010000
4	$1.000000000 \times 10^{-8}$	0.010000
6	$1.000000000 \times 10^{-12}$	0.010000

Observation 2.2

The ratio is the same at all six steps.0.010000 throughout—the resistance does not change on approach.

Observation 2.3

Falling geometrically, no finite number of steps reaches 0.Every step positive—not striking a wall, but forever advancing by the same fraction.

Observation 2.4

The steps required scale with the logarithm of the target.1.50 to 10^{-3} , 4.50 to 10^{-9} —exactly three times: each decade costs the same.

Observation 2.5

Reaching 10^{-18} costs twice that, 9.00 steps.9.00 against 9.00—matching an independently computed value: the proportionality holds.

Observation 2.6

So “how many more steps” always has an answer. Finite—every temperature is reached in finitely many steps. Only 0 is not.

3. Violate the Third Law and One Step Suffices

Computation 3.1: Replace the model with one whose entropy difference survives as $T \rightarrow 0$.

$$S_{\text{viol}}(T, b) = \left(\frac{T}{T+b} \right)^\alpha + \frac{0.3}{1+b}$$

The second term depends on b , so the two curves do not meet even at $T = 0$.

Model	Temperature after six steps
Satisfying the third law	1.000000×10^{-12}
Violating the third law	0 (at step 1)

Observation 3.2

The violating side reaches 0 in one step. Step 1—dramatically unlike the side that has not arrived after six.

Observation 3.3

The only difference is the second term. $0.3/(1+b)$ —containing no T , so it does not vanish as $T \rightarrow 0$.

Observation 3.4

So unattainability is a consequence, not a prohibition. The entropy difference vanishing as $T \rightarrow 0$ —that is Nernst’s heat theorem, and unattainability follows from it.

Observation 3.5

The two are said to be two statements of one third law. Nernst's form and the unattainability form—in this computation the first contains the second.

4. The Separator

The separator: is the unreachability a prohibition, or a rate of approach.

Observation 4.1

A prohibition means a wall. Resistance changing on approach—but the ratio stayed at 0.010000.

Observation 4.2

A rate of approach means a geometric fall. Forever the same fraction—which is what was measured.

Observation 4.3

And the corpus already uses this word in three senses. Paper 12 for the speed limit of light, Paper 82 for the threshold of Poincaré recurrence, Paper 126 for Carathéodory's adiabatic inaccessibility—absolute zero makes a fourth.

Observation 4.4

The four are distinct roots by the criterion of Paper 300. All are “unattainable”—a speed limit, a probabilistic waiting time, the reach of an adiabatic process, a lower bound on temperature. What forbids differs in every case.

Observation 4.5

The one in Paper 126 is the nearest neighbour, inside the same thermodynamics. Carathéodory's inaccessibility says that some points cannot be reached adiabatically in the space of equilibrium states—this one says that its edge cannot be reached in finitely many steps: the first is geometry, the second a limit.

Observation 4.6

This is one of the separators of Paper 481. When “it is said to be unattainable” is questioned—without naming which unattainability, the blame has four destinations.

Observation 4.7

To be honest—the model is not a real substance. $S = (T/(T + b))^\alpha$ carries only the property that entropies agree as $T \rightarrow 0$ —a real paramagnetic salt has different ratios and different step counts. What is shown is the direction: remove the property and zero is reached. These are not experimental numbers.

5. Roll Call and Closing

1. A factor of 0.010000 each step (Computation 2.1): the same at all six.
2. The resistance does not change (Observation 2.2): not a wall.
3. 4.50 steps to 10^{-9} (Observation 2.4): three times the 1.50 to 10^{-3} .
4. 9.00 steps to 10^{-18} (Observation 2.5): scaling with the logarithm.
5. The violating model reaches 0 in one (Computation 3.1): the core.
6. The only difference has no T (Observation 3.3): it survives $T \rightarrow 0$.
7. Unattainability is a consequence (Observation 3.4): it follows from Nernst.
8. Three earlier senses in the corpus (Observation 4.3): this makes a fourth.
9. The separator is prohibition or rate (Observation 4.4): distinct roots by Paper 300.
10. Not a real substance (Observation 4.7): a direction, not a measurement.

Closing: The unattainability of absolute zero is taken to be a prohibition—the third law forbids it, a picture of a wall. But if there were a wall the resistance should change on approach, each step buying less. Each step divides by the same factor—six cycles of adiabatic demagnetisation give 10^{-2} , 10^{-4} , 10^{-8} and 10^{-12} , with a ratio of 0.010000

at every step. The resistance does not change on approach. Falling geometrically, every step stays positive: not a wall, but forever advancing by the same fraction. The steps required scale with the logarithm of the target—1.50 to 10^{-3} , exactly three times that, **4.50**, to 10^{-9} , and twice again, **9.00**, to 10^{-18} . So “how many more steps” always has an answer: every temperature is reached in finitely many steps, and only 0 is not. Violate the third law and one step suffices—adding the term $0.3/(1+b)$, which survives as $T \rightarrow 0$, the same procedure reaches 0 at step 1.

Dramatically unlike the side that has not arrived after six. The only difference is that term, which contains no T . So unattainability is a consequence and not a prohibition: it follows from the entropy difference vanishing as $T \rightarrow 0$, which is Nernst’s heat theorem. The two are said to be two statements of one third law, and in this computation the first contains the second. One thing separates them—is the unreachability a prohibition, or a rate of approach. A prohibition means a wall, with resistance changing on approach—but the ratio stayed at 0.010000. A rate of approach means a geometric fall, forever the same fraction, which is what was measured. And the corpus already uses the word in three senses: Paper 12 for the speed limit of light, Paper 82 for the threshold of Poincaré recurrence, Paper 126 for Carathéodory’s adiabatic inaccessibility. Absolute zero makes a fourth. The four are distinct roots by the criterion of Paper 300—a speed limit, a waiting time, the reach of an adiabatic process, a lower bound on temperature—and what forbids differs in every case. The one in Paper 126 is the nearest neighbour, inside the same thermodynamics: there, some points cannot be reached adiabatically, which is geometry; here, the edge cannot be reached in finitely many steps, which is a limit. This is one of the separators of Paper 481: when “it is said to be unattainable” is questioned, without naming which unattainability the blame has four destinations. To be honest—the model is not a real substance. $S = (T/(T+b))^\alpha$ carries only the property that entropies agree as $T \rightarrow 0$, and a real paramagnetic salt has different ratios and step counts. What is shown is the direction—remove the property and zero is reached—not experimental numbers.

References

1. Masanes, L., & Oppenheim, J. (2017). A General Derivation and Quantification of the Third Law of Thermodynamics. *Nature Communications*, 8, 14538.
2. Nernst, W. (1906). Über die Berechnung chemischer Gleichgewichte aus thermischen Messungen. *Nachrichten von der Gesellschaft der Wissenschaften zu Göttingen*.
3. Nernst, W. (1912). Thermodynamik und spezifische Wärme. *Sitzungsberichte der Preussischen Akademie der Wissenschaften*.
4. Yamagishi, Y. (2026). *From Boundary Energy to Volume Energy* [Paper 12]. Zenodo. 10.5281/zenodo.21404703
5. Yamagishi, Y. (2026). *Time as a Renko Chart* [Paper 82]. Zenodo. 10.5281/zenodo.21735260
6. Yamagishi, Y. (2026). *The Existence of an Integrating Factor Does Not Give You a Temperature* [Paper 126]. Zenodo. 10.5281/zenodo.22079437
7. Yamagishi, Y. (2026). *The Three Hundredth Census: Whether Two Things Share a Root Is Decidable* [Paper 300]. Zenodo. 10.5281/zenodo.22171914

8. Yamagishi, Y. (2026). *The Order of Temperature Is Not the Order of Hotness* [Paper 403]. Zenodo. 10.5281/zenodo.22699405
9. Yamagishi, Y. (2026). *A Broken Law Can Be Blamed on Any of the Assumptions* [Paper 481]. Zenodo. 10.5281/zenodo.22733927

— *From thinking to syncing.* —

Yuuki YAMAGISHI (山岸 勇輝)

© 2026 Yamagishi Complexity Torus Lab, Japan · Licensed under Creative Commons Attribution 4.0 International (CC BY 4.0)