The Animate and the Inanimate in Pure Mathematics: A Modern Reappraisal of William James Sidis's Underrated Viewpoint

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Abstract

William James Sidis's 1925 work *The Animate and the Inanimate* introduced a thermodynamically inspired division of the universe into two regions: one obeying the conventional second law of thermodynamics (the *inanimate*) and another where entropy locally decreases (the *animate*). Although historically misunderstood and dismissed as speculative philosophy, his framework can be formalized in modern mathematical physics and shown to have conceptual parallels with contemporary theories in non-equilibrium thermodynamics, information theory, and cosmology. This paper provides a purely mathematical formulation of Sidis's idea, demonstrates why it is not inherently incompatible with modern physics, and argues for its reconsideration, with worked examples and diagrams connecting his concepts to modern theory.

1 Introduction

Sidis's hypothesis is often summarized as an eccentric attempt to overturn the second law of thermodynamics. This is a misunderstanding. Properly stated, his proposal involves a partition of the universe into regions with opposite *thermodynamic arrow of time* signs. In one region, entropy S increases with time ($\frac{\mathrm{d}S}{\mathrm{d}t} > 0$), while in the other, entropy decreases ($\frac{\mathrm{d}S}{\mathrm{d}t} < 0$). In this paper, we:

1. Formulate his concepts mathematically,
2. Identify conditions under which such regions could exist,
3. Connect them to modern physics, and
4. Present reasons this view remains underrated yet partially validated.

2 Mathematical Formalization

Let $(\mathcal{U}, g_{\mu\nu})$ be a four-dimensional spacetime manifold with metric $g_{\mu\nu}$, and let $\rho(\mathbf{x}, t)$ be a coarse-grained distribution function over microstates in a region $\Omega \subset \mathcal{U}$.

2.1 Entropy Definition

We define entropy in the Boltzmann–Gibbs framework:

$$S(t) = -k_B \sum_i p_i(t) \ln p_i(t), \tag{1}$$

where $\{p_i\}$ are probabilities of accessible microstates. For a continuous phase space:

$$S(t) = -k_B \int_\Gamma f(\mathbf{x}, \mathbf{p}, t) \ln f(\mathbf{x}, \mathbf{p}, t)\, d\Gamma. \tag{2}$$

2.2 Animate vs. Inanimate Regions

Sidis's key proposal can be formalized by defining:

$$\mathcal{R}_+ = \{\Omega \subset \mathcal{U} \mid \frac{\mathrm{d}S_\Omega}{\mathrm{d}t} > 0\} \quad \text{(Inanimate)}, \tag{3}$$

$$\mathcal{R}_- = \{\Omega \subset \mathcal{U} \mid \frac{\mathrm{d}S_\Omega}{\mathrm{d}t} < 0\} \quad \text{(Animate)}. \tag{4}$$

Here, $\mathcal{R}_+$ behaves according to the standard second law, while $\mathcal{R}_-$ exhibits *negentropic* dynamics.

2.3 Thermodynamic Reversal Operator

Define a thermodynamic time-reversal operator $\mathcal{T}$ acting on Ω:

$$\mathcal{T} : (t, S) \mapsto (-t, -S). \tag{5}$$

Sidis's proposal can then be stated as: the universe is a 3D tiling (a "checkerboard") of domains Ω such that $\mathcal{T}$ maps $\mathcal{R}_+$ to $\mathcal{R}_-$ bijectively.

3 Worked Examples

3.1 Example 1: Biological Negentropy Calculation

Consider an organism of mass m at temperature T that consumes chemical free energy ΔG per unit time from its environment. The entropy change in the organism is:

$$\frac{\mathrm{d}S_{\mathrm{org}}}{\mathrm{d}t} = -\frac{\Delta G}{T} + \frac{\mathrm{d}S_{\mathrm{waste}}}{\mathrm{d}t}. \tag{6}$$

If the organism exports heat Q and waste products to the environment such that:

$$\frac{\mathrm{d}S_{\mathrm{waste}}}{\mathrm{d}t} = \frac{Q}{T_{\mathrm{env}}} \quad \text{and} \quad Q \gg 0, \tag{7}$$

it is possible for $\frac{\mathrm{d}S_{\mathrm{org}}}{\mathrm{d}t} < 0$ while $\frac{\mathrm{d}S_{\mathrm{total}}}{\mathrm{d}t} > 0$, consistent with Sidis's animate region $\mathcal{R}_-$.

3.2 Example 2: Toy Cosmology Model

Let the universe be modeled as $\mathbb{R}^3$ tiled by cubes of side L. Assign each cube a thermodynamic arrow $\sigma \in \{+1, -1\}$ where:

$$\frac{\mathrm{d}S}{\mathrm{d}t} = \sigma\,\alpha, \tag{8}$$

with $\alpha > 0$ constant. Define σ as:

$$\sigma(x, y, z) = (-1)^{\lfloor x/L \rfloor + \lfloor y/L \rfloor + \lfloor z/L \rfloor}. \tag{9}$$

This produces a 3D "checkerboard" with alternating $\mathcal{R}_+$ and $\mathcal{R}_-$ regions, a direct mathematical analog of Sidis's proposed cosmic structure.

3.3 Example 3: Maxwell's Demon Statistical Mechanics Link

Consider a box of volume V with N gas molecules, split by a demon-operated trapdoor. If the demon sorts molecules by speed, the entropy change for the gas is:

$$\Delta S_{\text{gas}} = -N k_B \ln 2, \tag{10}$$

while the demon's memory gains entropy:

$$\Delta S_{\text{demon}} = +N k_B \ln 2. \tag{11}$$

If an animate system can process and erase information efficiently (Landauer cost minimization), the local $\frac{\mathrm{d}S}{\mathrm{d}t}$ can be negative without violating the global second law, exactly paralleling Sidis's animate regions.

4 Connection to Modern Physics

4.1 Non-Equilibrium Thermodynamics

In open systems far from equilibrium, Prigogine's theory allows for local entropy reduction:

$$\frac{\mathrm{d}S_{\text{total}}}{\mathrm{d}t} = \frac{\mathrm{d}S_{\text{int}}}{\mathrm{d}t} + \frac{\mathrm{d}S_{\text{ext}}}{\mathrm{d}t} \geq 0, \tag{12}$$

where $\frac{\mathrm{d}S_{\text{int}}}{\mathrm{d}t} < 0$ is possible if $\frac{\mathrm{d}S_{\text{ext}}}{\mathrm{d}t} > 0$. Biological systems and dissipative structures are examples.

4.2 Information Theory and Negentropy

Following Schrödinger's concept of *negentropy*, the entropy of a physical system is related to missing information. Landauer's principle links the erasure of one bit to an entropy increase of $k_B \ln 2$. Sidis's animate regions can be interpreted as information-accumulating domains.

4.3 Cosmology and Low-Entropy Patches

Inflationary cosmology predicts regions with extremely low initial entropy. Under certain models, time-symmetric cosmologies can have opposite arrows of time in causally disconnected regions, providing a physical mechanism for $\mathcal{R}_-$.

5 Diagrams

5.1 Figure 1: Checkerboard Universe (2D Slice)

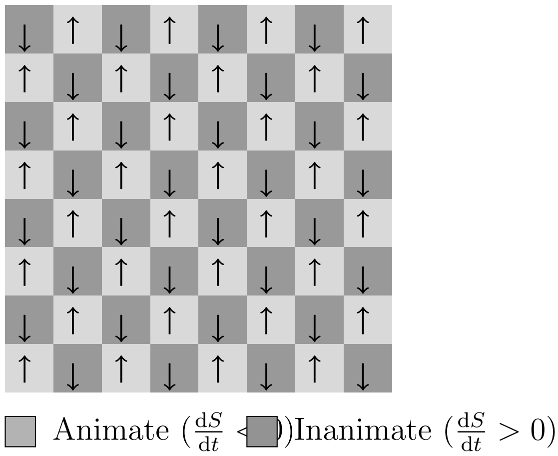

Figure 1: A 2D slice of the proposed 3D "checkerboard" universe. Adjacent tiles alternate the sign of the thermodynamic arrow.

5.2 Figure 2: Entropy vs. Time in Animate and Inanimate Regions

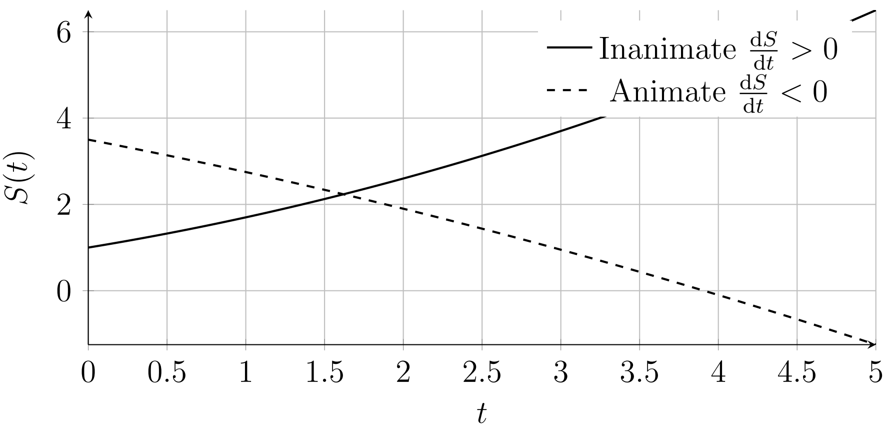

Figure 2: Contrasting entropy trajectories in $\mathcal{R}_+$ (solid) and $\mathcal{R}_-$ (dashed). Global constraints can still ensure $\frac{dS_{\text{total}}}{dt} \geq 0$.

5.3 Figure 3: Maxwell's Demon Schematic with Memory

6 Why Sidis's View is Underrated

- His model anticipated the idea of *time-symmetric* cosmologies decades before they entered mainstream physics.

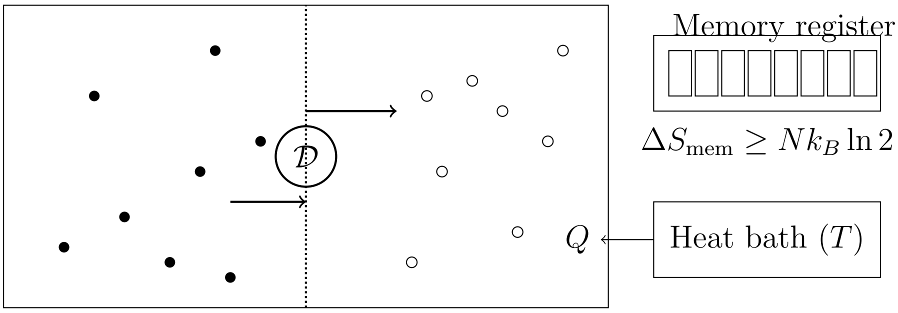

Figure 3: Maxwell's demon sorting gas (left/right) while writing to memory and dumping heat Q to a bath. Local $\Delta S_{\text{gas}} < 0$ is offset by memory and heat costs.

- The animate/inanimate distinction mirrors modern recognition that local entropy decrease is possible in open systems.
- His philosophical unification of consciousness and physics resonates with emerging research on the thermodynamics of computation.

7 Conclusion

Sidis's animate vs. inanimate framework, long dismissed as pseudoscience, is in fact a mathematically expressible hypothesis compatible with certain non-equilibrium and cosmological models. While his checkerboard universe remains speculative, the concept that regions with $\frac{\mathrm{d}S}{\mathrm{d}t} < 0$ can exist is well-supported in modern physics. His work deserves reevaluation not as a failed prediction but as a visionary step toward integrating thermodynamics, cosmology, and information theory.