

THE CONCEPT OF ENTROPY IN THE ARTS AND HUMANITIES

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Introduction

The concept of entropy was developed in nineteenth century thermodynamics as a measure of the amount of energy unavailable to do useful work in a system. Since then, entropy has been recognized as a measure of disorder in, or lack of information about, any system. Several writers have used the image of a library as an orderly system in explaining how increased work is required to retrieve information if a system's entropy increases (e.g., if a library becomes disorganized when several two-year-old children use the collection). Jeremy Campbell's book *Grammatical Man* has brought together ideas on entropy from fields as diverse as biology, information theory, psychology, and linguistics¹. Campbell also pursues the recently developed idea that increasing entropy (disorder and diversity) is necessary for the evolution of more complex and highly ordered systems.

Writers in the arts and humanities have used the term entropy in an intriguing variety of ways. A bibliography prepared in

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connection with an earlier paper by the authors provided references for further study of the concept's uses in these fields, by authors, artists, and their critics². In addition to examining the role of the concept of entropy in idea productivity, the paper also discusses some problems of transferring a concept from one field to another. Finally, a brief investigation of the frequency of use of the word "entropy" in recent works may provide clues to the relative importance of the concept.

Entropy as a Metaphor in Religion

In "The Uses and Abuses of Thermodynamics in Religion," Erwin Hiebert describes how "[t]he first and second laws of thermodynamics have been used, affirmed, rejected, manipulated, exploited, and criticized in order both to further and to censure religion"³.

The idea of the heat-death of the universe clearly has important religious implications. What Hiebert terms "the boredom or Nirvana," or "the new Götterdämmerung" associated with the end of the world implies also that there was a clear, orderly beginning at the other end of time's arrow. William Ralph Inge, Dean of St. Paul's in London, pointed out that this lends support for the Christian doctrine of God's creation of the world from nothing.

However, the coming thermal equilibrium raised many questions about man's relation to God. "Was it consistent with God's goodness to annihilate creation through the heat-death? What meaning could be attached to any values—in the mind of God—when man's history on earth was terminated? . . . Did 'God,' indeed, have any meaning in a universe that was not an abode for conscious life?"⁴

The second law, with its expression of ever-increasing disorder, seems to contradict the more optimistic theory of evolution. As popularized in the nineteenth century, the theory

of evolution encouraged the view of increasing complexity and development toward biological and social perfection. Inge, the "gloomy dean," pointed to the conflict between the two scientific theories. His criticisms anticipate recent efforts of scientific creationists to discount the theory of evolution by "proving" its scientific unacceptability.

Entropy as a Metaphor for Artists

Thomas Pynchon has used entropy as a central theme or problem in his short stories and novels. Having studied physics and information theory as well as literature in college, he is able to draw on various views of and approaches to resolving the problems he creates in his fiction. William Plater has traced a "Maxwell's demon" role in which players attempt to decrease the entropy in the fictional world of the Pynchon novels. In *The Crying of Lot 49* a character tracks clues to a will, "as if they were molecules, trying to differentiate between the reality and the illusion . . . as if to sort her information into some order"⁵.

Later, in *Gravity's Rainbow*, the Maxwell's demon character learns "everyone promises ya somethin' fer nothin', right? yes, now oddly enough, that's the main objection engineers and scientists have always had to the idea of . . . perpetual motion or as we like to call it Entropy Management"⁶. In this work Plater notes "lives are being sorted instead of molecules," and Maxwell's demon "fades from the world . . . perhaps through the process of converting information to energy"⁷.

Plater goes on to explain how Pynchon's work with information, communication, and entropy forms an important, recurring theme: "how is significant communication possible against a background of increasing disorder and noise if the alternative is redundancy, banality, and a predetermined structure?"⁸

More poetic (if less clearly scientifically identifiable)

attempts to express the concept of entropy have been made. Bin Ramke's "Entropy" ends with the stanza

A man drives his car in the desert,
he is alone. Our city lights the sky
in a small corner of his horizon.
Soon he will sleep, or die, and dream
of acres and acres of poppies
with butterflies skimming their surface
and a few magnificent spiders
drifting on threads,
riding alone the waves of heat⁹

In "from Entropisms" Harriet Zinnes contrasts images of summer, heat, the sun, and fire building with man's lack of awareness of and unconcern for the world in which these occur¹⁰.

There poets' view of the heat death of the universe portrays stifling heat. However, the heat death in thermodynamics would be at a temperature just above absolute zero. Somehow humans seem more ready to accept enervation and total dissipation of energy as occurring in the sweltering heat. As Robert Frost phrased the point,

Some say the world will end in fire,
Some say in ice.
From what I've tasted of desire
I hold with those who favor fire.

The graphic artist's uses of the concept of entropy are also intriguing. John Coplans observes that Robert Smithson's repeated use of "the spiral is related to his notions of entropy and irreversibility. A spiral vectors outward and simultaneously shrinks inward — a shape that circuitously defines itself by entwining space without sealing it off"¹¹. Smithson's earthworks, such as "Spiral Jetty" and "The Amarillo Ramp" use this image

and involve the viewer as participant in a difficult (the works are hard to climb) and ultimately not intrinsically fulfilling experience (there's nothing more than a different view when you reach the end). Hayden Herrera states that " 'primal ooze' had a special entropic appeal" for Smithson, too¹². The use of asphalt or another viscous substance to spill into and over a rock quarry, for example, creates a sense of decreasing order.

Smithson's "Partially Buried Woodshed" was a shed covered with dirt until the roof beam broke. In Joseph Masheck's view, this is where Robert Grosvenor begins, with his "Fractured Beams"¹³. Working with a utilitarian object such as a telephone pole or a plank, Grosvenor purposefully destroys its usefulness, producing jagged complete or partial breaks.

Grosvenor's energetic intervention and resulting dramatic changes in the art object are opposite to the effect Robert Ryman creates with his paintings. Expressing the thermodynamic trend toward a levelling of all differences, Ryman is a proponent of the reductionist approach. In reviewing Ryman's work, Donald Kuspit remarks, "the pictures do not give: the sheer givenness of paint disavows any imagistic residue or emotive intimation. One finds 'higher meaning' . . . in them at one's peril"¹⁴.

Entropy as a Construct in Criticism and Analysis

In the graphic arts the attribution of entropy as a theme in an artist's work is generally done by a critic, not by the artist himself. While some artists do make a point of explaining and expounding on their graphic statements about entropy (Robert Smithson was a good example), the critic's perception and verbal interpretation of the work may provide the first conscious application of the term "entropy."

Literary critics have also discovered entropy after the fact in various authors' works. Stanley Angrist and Loren Hepler provide the literary world with a brief introduction to ther-

modynamics, and explain “[t]he concept of spending high-quality energy to obtain information may be applied far and wide, even to poetry. Poets frequently do not say exactly what they mean — that is, they transmit a coded message. If the code is to be broken, the second law says that a price must be paid for the information”¹⁵. They go on to recognize images of entropy in Robert Frost’s “Mending Wall”.

Something there is that doesn’t love a wall
That wants it down

In Carl Sandburg’s “Under”:

I am the undertow
Washing tides of power
Battering the pillars
Under your things of high law.
...
I am the crumbler: tomorrow.

And in H.G. Wells’ account of the dying earth in *The Time Machine*.

At last, more than thirty million years hence, the huge redhot dome of the sun had come to obscure nearly a tenth part of the darkling heavens . . . the red beach, save for its vivid green liverworts and lichens, seemed lifeless . . . A bitter cold assailed me . . . There were fringes of ice along the sea margin, with drifting masses further out . . . The darkness grew apace . . . From the edge of the sea came a ripple and whisper. Beyond these lifeless sounds the world was silent.

Critics have found allegorical references to entropy in writers from Hawthorne to Wallace Stevens. According to Andre Le Vot, modern writers whose works deserve thermodynamic inter-

pretation include Flannery O'Connor, E.L. Doctorow, Jerzy Kosinski, John Hawkes, and Kurt Vonnegut, as well as Thomas Pynchon¹⁶.

The decadence or decay which may symbolize increasing entropy seems especially effective when expressed in French. Critics have noted the increasing entropy in the world of Samuel Beckett's plays, especially "Waiting for Godot," in which the characters deteriorate physically and mentally while waiting for something which never happens.

Another way of looking at entropy in literature is seen in Marilyn Caddis Rose's "Entropy and Redundancy in Decadent Style." She describes the Decadent style as "verbose . . . intense self-consciousness, restless curiosity, over-subtilizing refinement, spiritual and moral perversity," of which "not a single piece can hold our attention on its own merits *qua* literature"¹⁷. Her suggestion is that human readers bring a sense of time to their reading, and that "[i]n the end . . . Decadent writers misuse the space-time components of poesy, and that misuse would help explain why we find them everlasting bores"¹⁸.

Entropy and Language

Shannon's experiments with random selection of letters to form "words" were those of an early player in the entropy, language, and meaning game. More recently, Jeremy Campbell's *Grammatical Man* does an excellent job of pulling together the pieces of information theory to present his view of language as a limiting, ordering, defining, and thus highly creative tool.

John Freund, in "Entropy and Composition," contributes to the discussion as well. He contends that "[v]erbal composition, like any other form of communication, seeks to resolve uncertainty"¹⁹. However, he observes, the act of creative writing is for the writer an entropy-increasing (even painful) process. Therefore writers engage in various prewriting strategies, such as

out-lining, reading, or reviewing notes to decrease entropy. The conflict between the need for looseness or play in the language and the need for structure or order for communication is crucial. Some writers seek structure through rhyme schemes of rhythmic patterns, or (in one extreme example) writing a novel without using the letter "e". Still, overly rigid schemes or formulas for writing produce a "stale" product and good creative writing involves striking a balance between play and order.

Entropy in Music and the Fine Arts

Leonard Meyer begins his essay on "Meaning in Music and Information Theory" with the observation that there are parallels, even equivalents, between musical experience and information theory; notably "[t]he importance of uncertainty in musical communication [and] the probabilistic nature of musical style"²⁰. In appreciating music, the listener's knowledge of what has come before (in the piece) allows him to estimate-probable patterns of continuation. Once the listener learns which pattern *does* follow, his uncertainty is reduced, and he has gained information.

Meyer notes the importance of redundancy in allowing the listener to think of probable patterns, and in combatting noise – he distinguishes between acoustic noise (in the physical transmission of sound) and cultural noise (relating to musical style)²¹. The need for redundancy to allow effective communication is the cornerstone of Meyer's later criticism of serial music, which "presents the listener with so much novel, densely packed material that even those parts of the musical message which might have been intelligible are often masked and confused by the welter of incoming information"²².

In *Entropy and Art* Rudolf Arnheim stresses the conflict between the need for order or reduction of tension and the "anabolic tendency," a tendency toward a structural theme²³.

While “mere orderliness leads to increasing impoverishment and finally . . . the absence of order,” the counter principle for “creation of a structural theme . . . establishes ‘what the thing is about’ ”²⁴. It is the artist’s role to balance these two tendencies. Arnheim cites a story about composer Arnold Schoenberg. When someone threatened to cut one of his works (structures), Schoenberg responded it would still be a long piece, which would be too short in various places²⁵.

The Problem of Transferability

As the concept of entropy has moved from thermodynamics to information theory to art criticism, questions have been raised concerning the appropriateness of the transfer. One of the early cautions came from Claude Shannon in 1956. “I personally believe that many of the concepts of information theory will prove useful in these other fields . . . but the establishing of such applications is not a trivial matter of translating words into a new domain, but rather the slow tedious process of hypothesis and experimental verification”²⁶.

Questions about transferring a scientific construct to the arts and humanities have been raised by others, and often these writers cite their credentials as scientists. Arnheim’s book sparked a lively debate in the pages of *Leonardo* in 1973. Richard Land’s review of the argument and comment on some problems in the book is particularly instructive²⁷. He notes Arnheim’s lack of a clear definition of “order” and his use of the word “information” when referring to “meaning”.

More recently, Freund’s essay on entropy and composition prompted comments by David Vander Velde criticizing the lack of a quantifiable measure of the entropy overcome in writing well²⁸. He suggests that entropy be considered only as a metaphor, illustrating but not explaining the writing process.

The problem of how far one can move an idea from its

original discipline is arguable. A "strict constructionist" approach may leave us with well defined terms of limited usefulness, while haphazard borrowing and sloppy scholarship can reduce the value of the connections drawn. The need for some acceptance of constructs from other disciplines is clear in Myron Tribus' account of Shannon's choice of the word entropy after discovering the principle. He claims John von Neumann suggested the term "for two reasons . . . [the] uncertainty function has been used in statistical mechanics under that name . . . and more important, no one knows what entropy really is, so in a debate you will always have the advantage"²⁹.

Frequency of Use of the Term "Entropy"

From the brief overview above, it is evident that the concept of entropy has been used in the arts and humanities by creative artists, their critics, and by writers on the philosophy of art. At least some of these uses represent insightful contributions—but are these isolated cases, or has entropy joined the mainstream of artistic creativity and analysis?

In attempting to answer this question, the number of citations which include the word "entropy," or some form thereof, was obtained for twelve on-line databases. For comparison, representative databases in the sciences and social sciences, as well as all available databases in the arts and humanities were checked using Dialindex³⁰. Not surprisingly, the largest contributor was *Chemical Abstracts*, with 23,985 items which include the word "entropy," while at the low end *Historical Abstracts* contributes six, and *RILM Abstracts* (music literature) three citations.

The number of citations alone says fairly little about the relative importance of entropy in various disciplines. The *Chemical Abstracts* database is much larger than *RILM Abstracts*, and one would expect the size of the file searched to have some

impact on the number of "entropic citations" found. To allow for this, the size of each database, as given in *Computer Readable Databases* was used to compute the percentage of entropy-containing citations³¹. The databases, number of citations using the word entropy, and percentage of the data base these citations represent are given below:

Dialindex Search Results

Database	Entropy Citations	Percentage of Database Entropy Citations
Chemical Abs.	23985	.4525
NTIS	2324	.2869
Language Abs.	49	.0980
Sociological Abs.	65	.0575
Artbib. Modern	17	.0354
Conference Papers	316	.0345
Comp. Dissert. Ind.	244	.0323
Soc. Sci. Cit. Ind.	282	.0295
MLA Bibliography	44	.0208
RILM	3	.0097
America Hist. & Life	8	.0060
Historical Abs.	6	.0056

As might be expected, the science and technology databases rank at the top, having the largest percentage of entropy references, while the two history files have the smallest percentage. The social sciences (*Sociological Abstracts* and *Social Sciences Citation Index*) join the "general research/academic" group (*Conference Papers Index* and *Comprehensive Dissertation Index*)

near the middle. No clear position is obvious for the arts and humanities databases. *Language and Language Behavior Abstracts* ranks third, *Art Bibliographics Modern*, fifth, *MLA International Bibliography* is ninth, and *RILM Abstracts* tenth.

From this brief analysis one may attempt to answer the question "how much difference does the concept of entropy make in the arts and humanities?" The answer depends at least on how one defines "arts and humanities." In some fields entropy seems to play a role in the published literature, while in others, especially if history is considered part of the humanities, entropy is a fairly insignificant topic of discussion.

Conclusion

Even this cursory overview of uses of the concept of entropy reveals a number of ways the thermodynamic construct has served as a metaphor or an inspiration in fields far from its "home." While questions have been raised about the appropriateness of the transplantation, entropy seems to have become part of the intellectual landscape in some of its new environments.

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