

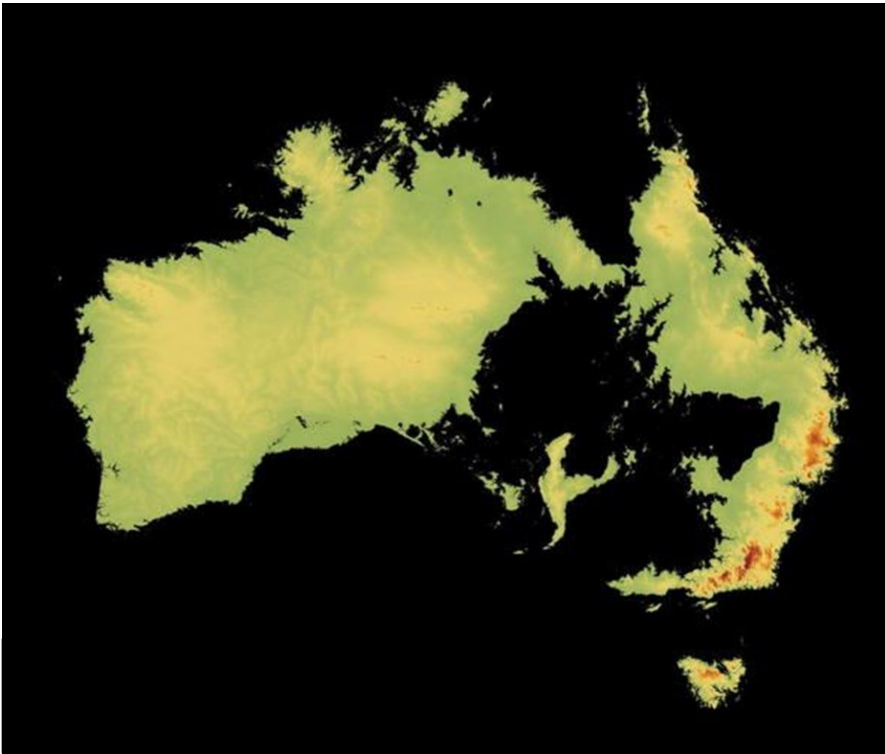
Worldbuilding with equations, cosmology, climate change and social credits:

Iridio Ennui vs the Boltzmann Brains

Mario Daniel Martín

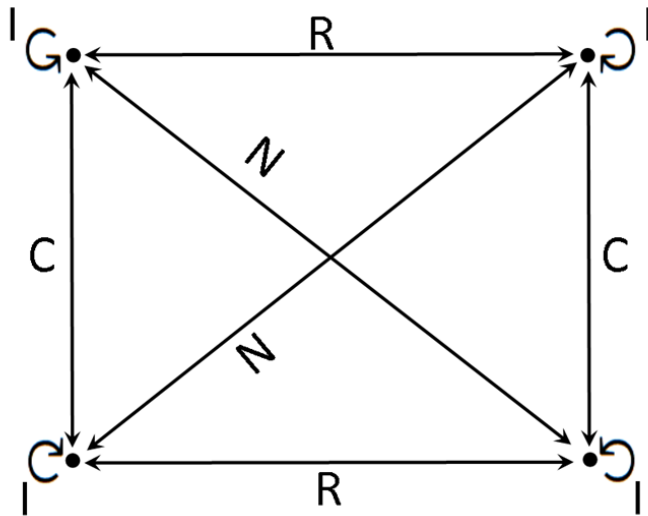
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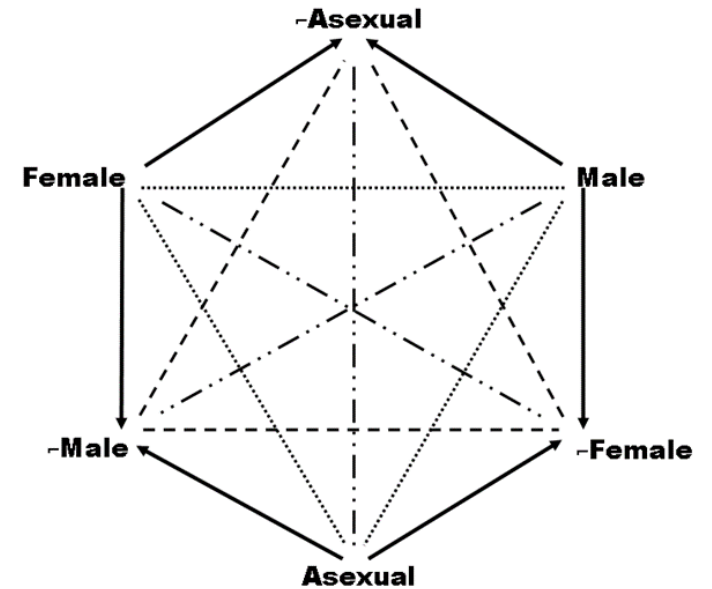
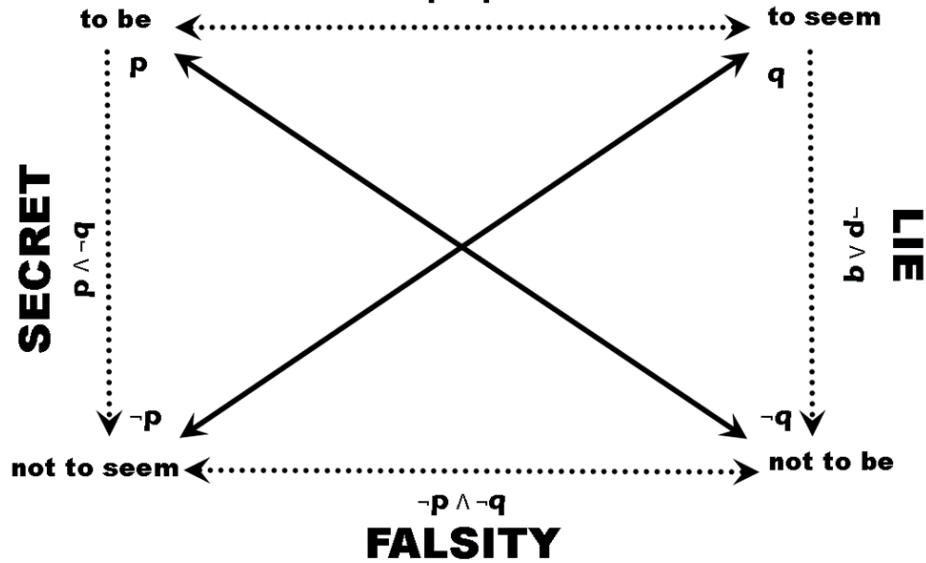
Paper presented at the Australasian Universities Languages & Literature Association (AULLA) and Australian Reception Network (ARN) Conference *Reception, Production, Exchange*, University of Wollongong, December 2019

Preliminary Theory



TRUTH

$$p \wedge q$$



$\exists x \quad \overline{\Phi x}$	$\overline{\exists x} \quad \overline{\Phi x}$
$\forall x \quad \Phi x$	$\overline{\forall x} \quad \Phi x$
$\$$	$S(\overline{A})$ a
Φ	La

Man

Woman

NOVUM: A key concept to talk about science fiction

novum *n*

L. “new” the primary element in a work of science fiction by which the work is shown to exist in a different world than that of the reader.

Source: The Oxford Dictionary of Science Fiction. Edited by Jeff Prucher (2006)
Oxford University Press

SF is distinguished by the narrative dominance or hegemony of a fictional "novum" validated by cognitive logic

Source: Suvin, Darko (1979) *Metamorphoses of Science Fiction: On the Poetics and History of a Literary Genre*. New Haven and London: Yale University. Press, page 63

Key definition 1: Conventional vs Experimental Science Fiction

*SF can act as a mirror or as a window depending on how it is maneuvered by the author. It is like a pane of glass that can behave in two ways. If held so that the light shines directly through it onto the author's creations, the reader is sometimes fooled into thinking that the glass is not there, that he is seeing genuine aliens, genuine futures, genuine other worlds that have nothing to do with him, the wonders of other places and times, of pure escape, of playing in the presumed sensation of difference. But if held in a slightly different way, a pane of glass also reflects, and the onlooker might catch a glimpse of himself, might see his own image even stronger than that of the new scene. When such occurs, SF reflects the perceiving subject, dialectically "objectifies" him to himself as one who cannot be avoided when looking at those supposedly new scenes, because he is both the perceiving subject and often the creator of those scenes. *Conventional SF is tilted so that we do not see the glass; experimental SF is arranged so that we do.**

Source: Albert Wendland (1985) *Science, Myth, and the Fictional Creation of Alien Worlds*. Studies in Speculative Fiction, No. 12. Ann Arbor: University of Michigan Research Press, pages 6-7

Key definition 2: Carl D. Malmgren's definition of a *fictional universe* to characterise SF

The first step in defining the genre of science fiction is to specify the components of a **fictional universe in general**. Working inductively, we can say that a fictional universe invariably consists of two major components or systems, roughly equivalent to the lexicon and syntax of a language-**a world** and **a story**.

The world includes the total repertoire of possible fictional entities, that is, the characters, settings, and objects (in SF these would include gadgets, inventions, discoveries, etc.) that occupy the imaginal space of the fiction.

The story connects and combines the various entities, at an abstract level it consists of a systematic set of rules governing the order and arrangement of those entities concatenating their interactions.

Now, **the generic distinctiveness science fiction lies not in its story but in its world. *The various plots of science fiction, once divested of their alien, other-worldly, or futuristic appurtenances, coincide with the plots of realistic fiction.***

Source: Malmgren (1991) "Against Genre/Theory: The State of Science Fiction Criticism". *Poetics Today*, Vol. 12, No. 1 (Spring, 1991), pp. 125-144

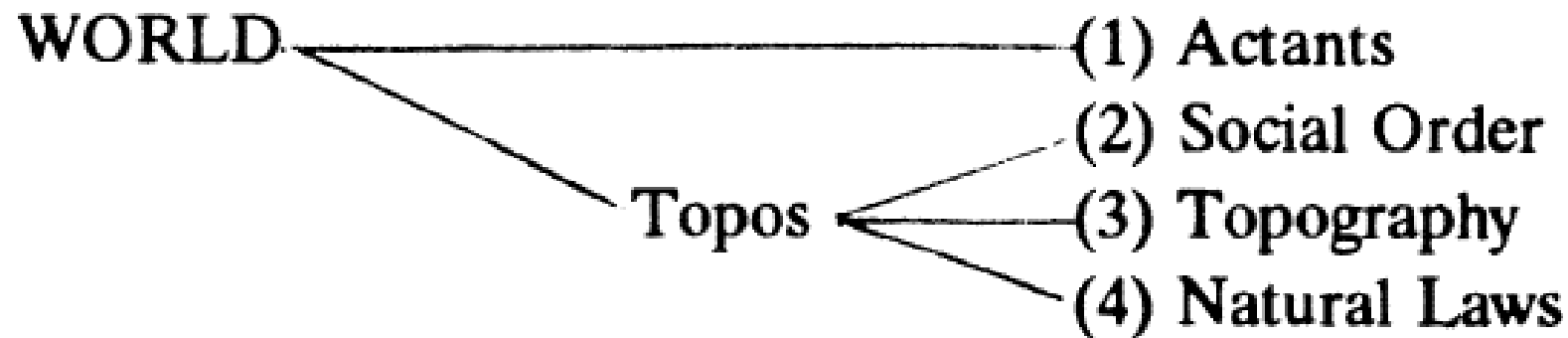
When discussing the fictional worlds of science fiction, to avoid the implicit assumption that the characters are human and the settings terran, I shall use the terms **actants** and **topoi**.

To summarize, then, a world consists of a number of actants who populate, occupy, or exist in certain implicit or particularized topoi.

Science fiction creates its worlds by inserting at least *one factor of estrangement from the basic narrative world of the author* into its system of actants or topoi.

Once the author has posited the factor(s) of estrangement, the discursive conventions of the genre dictate that the fiction adhere thereafter to the laws of nature and the assumptions of the scientific method and that it systematically account for its elements of estrangement, its *novums*

Source: Malmgren (1991) “Against Genre/Theory: The State of Science Fiction Criticism”. *Poetics Today*, Vol. 12, No. 1 (Spring, 1991), pp. 125-144



Typology of Science Fiction*

World Component	Novum	Genre	Representative Examples		Themes
		SF Types	Extrapolative Speculative		
ACTANT	Alien/Monster	Alien Encounter	<i>Frankenstein</i>	<i>Solaris</i>	Self-&-Other
SOCIAL ORDER	Utopia/Dystopia	Alternate Society	<i>We</i>	<i>Dhalgren</i>	Self-&-Society
TOPOGRAPHY:					
OBJECT	Invention/Discovery	Gadget SF	<i>I, Robot</i>	<i>Roadside Picnic</i>	Self-&-Technology
PLANET	Catastrophe/Alien Landscape	Alternate World	<i>Ringworld</i>	<i>Ubik</i>	Self-&-Environment
NATURAL LAW:					
SCIENCE	Magic/Occultism	Science Fantasy	<i>Conjure Wife</i>		Epistemology & Ontology
THEORY	Time Looping		"All You Zombies"		
SCIENTIFIC FACT	Reversal/Denial		<i>The Martian Chronicles</i>		
HISTORICAL FACT	Reversal/Denial		<i>The Man in the High Castle</i>		
NATURAL ACTANT	Counternatural Actant		<i>More Than Human</i>		

Source: David Ketterer (1992) "Review: A Typology of SF" *Science Fiction Studies*, Vol. 19, No. 1 (Mar., 1992), pp. 109-116. Reviewed Work: *Worlds Apart: Narratology of Science Fiction* by Carl D. Malmgren

Key definition 3: Carl D. Malmgren's characterisation of *Science Fantasy* (a mixed genre between Science Fiction and Fantasy)

A science-fantasy world, would be one in which *the actants or topoi presuppose at least one deliberate and obvious contravention of natural law or empirical fact*, but which *provides a scientific rationale for the contravention* and explicitly grounds its discourse in the scientific method and scientific necessity.

The fact that science fantasy is grounded in the discourse of scientific necessity and adheres to the scientific method guarantees that its worlds will have an internal consistency or logical explicability that is intellectually satisfying. But the contravention of natural law or empirical fact that defines the genre makes possible the introduction of actants, motifs, and topoi which play upon a wide range of human emotional needs while at the same time suspending the mimetic contract and its attendant responsibilities.

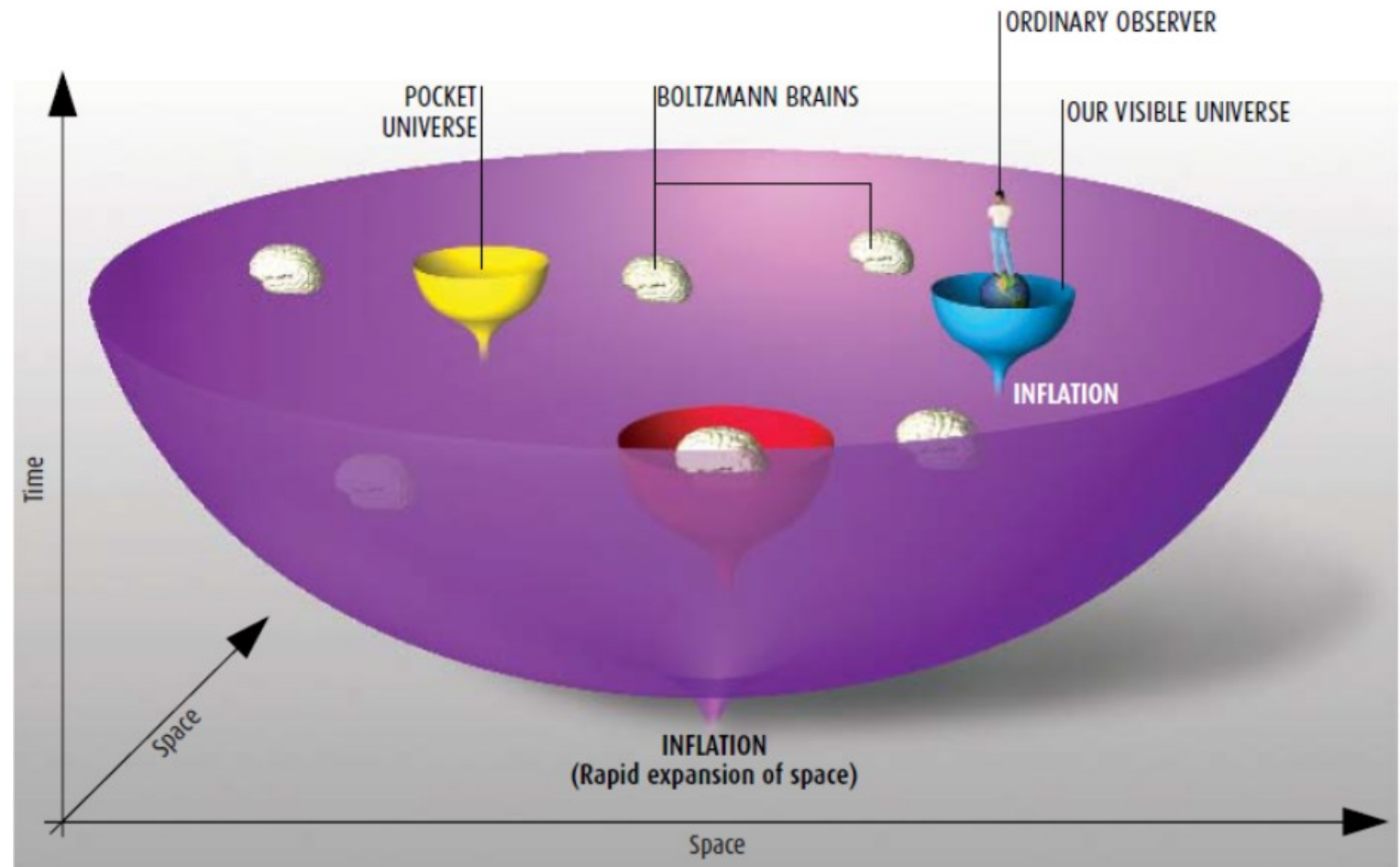
Source: Malmgren (1988) "Towards a Definition of Science Fantasy". *Science Fiction Studies*, Vol. 15, No. 3 (Nov., 1988), pp. 259-281

From entropy to Boltzmann brains

OBSERVERS OF THE MULTIVERSE

If the model of eternal inflation is correct, our universe is one of many in a "multiverse"

Given enough space and time, it is possible that minimally conscious observers called "Boltzmann brains" could pop into existence, and outnumber "ordinary" observers like us. This threatens the crucial assumption that we are typical observers, so cosmologists are grappling with ways to count the ratio of Boltzmann brains to ordinary observers in an effort to explore the structure of the multiverse

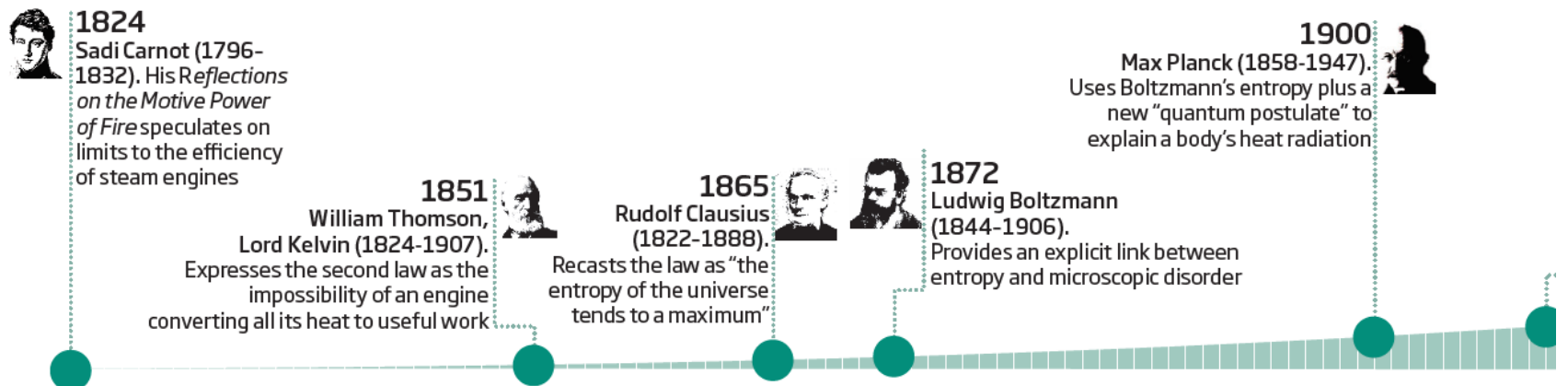


The Second Law of Thermodynamics

Ludwig Boltzmann, Josiah Willard Gibbs, and James Clerk Maxwell formulations:
Any system which is free of external influences becomes more *disordered* with time.
This disorder can be expressed in terms of the quantity called *entropy*.

Entropy increasing

From a tightly defined origin in the workings of steam engines, the influence of the second law of thermodynamics has steadily spread over the past 200 years



Boltzmann reformulation of the second law in terms of statistical mechanics

Entropy is defined statistically, not as a law where it always increase by definition (it can decrease)

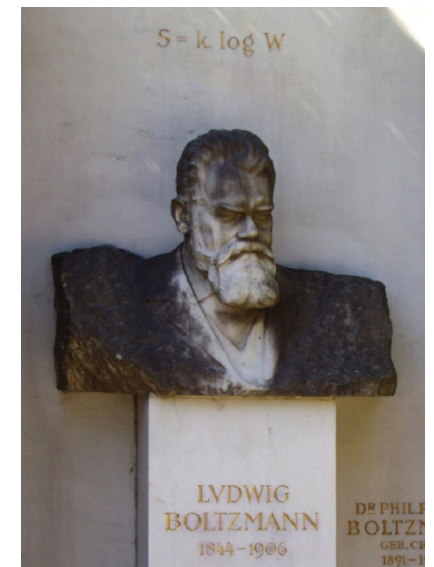


This key issue of typicality also confronted Austrian physicist and philosopher Ludwig Boltzmann. In 1897 he posited an infinite space-time as a means to explain how extraordinarily well-ordered the universe is compared with the state of high entropy, or disorder, predicted by thermodynamics. Given such an arena, where every conceivable combination of particle position and momentum would exist somewhere, he suggested that the orderliness around us might be that of an incredibly rare fluctuation within an infinite space-time.

Disembodied brains

Boltzmann's reasoning, however, was undermined by another, more absurd, conclusion. Rare fluctuations could also give rise to single, momentary brains – self-aware entities that spontaneously arise through random collisions of particles. Such “Boltzmann brains”, the argument goes, are far more likely to arise than the entire visible universe or even the solar system. An infinity of space would therefore contain an infinitude of such disembodied brains, which would then be the “typical observer”, not us.

Can this bizarre vision possibly be real, or does it indicate something fundamentally wrong with our notion of “typicality”?



Boltzmann's explanation of why our universe began with low entropy is the origin of the “Boltzmann Brains paradox”

In the early 1990s it was shown experimentally that the probability of a decrease in entropy (a fluctuation apparently violating the second law) depends on the size of the system and the time one has to wait for a fluctuation to occur.

But in 1998 it was shown that the universe expands at an accelerated rate.

If the universe expands infinitely (and lasts a very long time) any fluctuation, even the most improbable, is possible.

This is the source of the “Boltzmann brain paradox”

$$\frac{\Pr(\bar{\Sigma}_t = A)}{\Pr(\bar{\Sigma}_t = -A)} = e^{At}$$

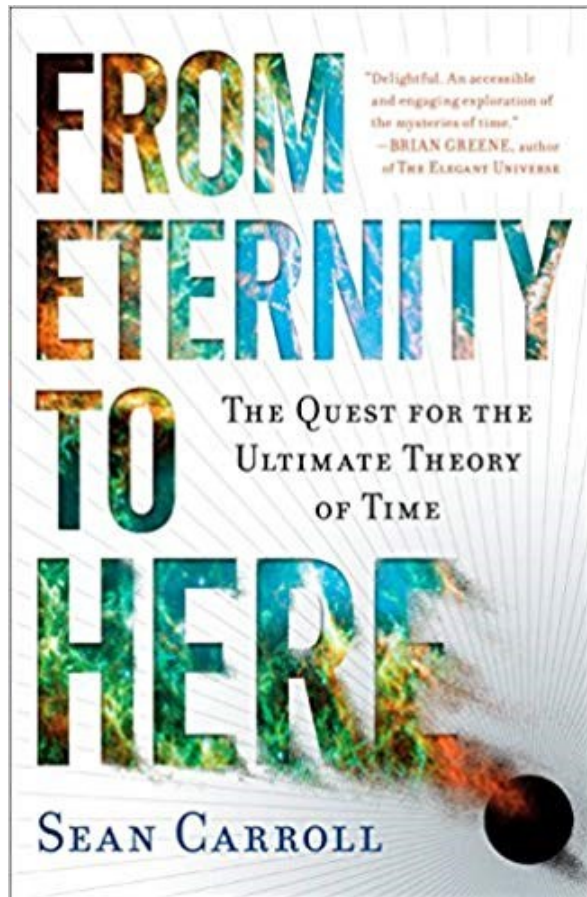
The fluctuation theorem

This suggests that it is more probable than a brain fluctuates itself into existence than a planet (or a galaxy) where evolutionary life would emerge

A big issue is that BBs will become the most frequent “observers” of the universe, because they are more probable than evolutionary observers (like us or extra-terrestrials)

Boltzmann brains according to Sean Carroll, Albretch & Sorbo, and others

They are essentially smaller fluctuations than the fluctuation required to create a universe (if entropy à la Boltzmann is accepted)



The main use of the concept in the scientific literature has been to discriminate between cosmological models. Those that predict Boltzmann brains are bad or wrong ones.

Why Boltzmann Brains Are Bad

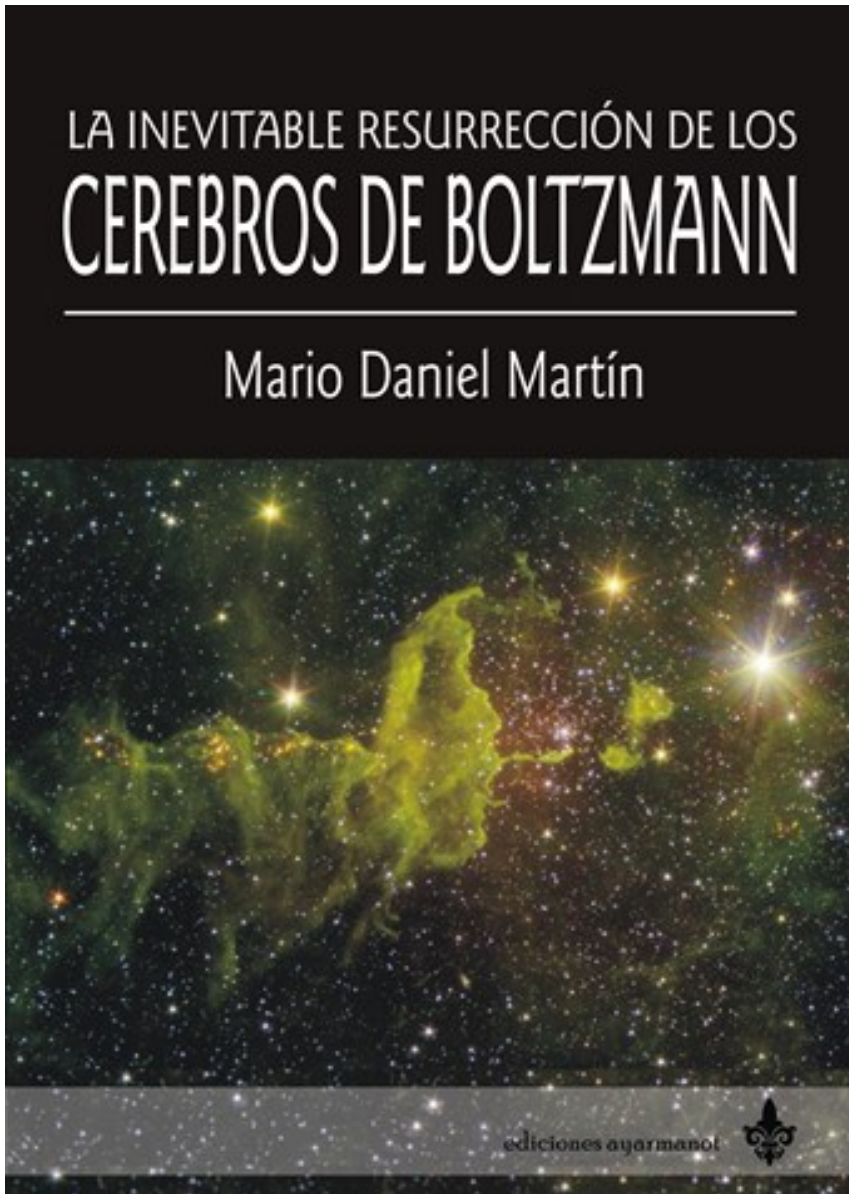
Sean M. Carroll

Walter Burke Institute for Theoretical Physics
California Institute of Technology, Pasadena, CA 91125, U.S.A.

The rate of Boltzmann brains (BB) over normal observers (NO) in a multiverse	$\frac{\mathcal{N}^{\text{BB}}}{\mathcal{N}^{\text{NO}}} \approx \frac{\sum_j H_j^3 \mathcal{K}_j^{\text{BB}} s_j}{\sum_{i,k} n_{i,k}^{\text{NO}} \mathcal{K}_{i,k} s_k}$
The Boltzmann suppression factor (an estimate for the nucleation rate of a Boltzmann brain of mass M in any particular quantum state)	$\Gamma_{\text{BB}} \sim e^{-M/T_{\text{dS}}} e^{S_{\text{BB}}} = e^{-F/T_{\text{dS}}}$ Where S_{BB} is the entropy, and $F = M - T_{\text{dS}} S_{\text{BB}}$ is the free energy of the Boltzmann brain.
Estimation of the number of Boltzmann's brains in a pocket universe of volume $e^{3H_{\Lambda} t}$	$n_{\text{CB}} \sim \exp \left\{ -N^{4/3} \frac{m_{\text{p}}}{m_{\text{e}} \alpha} + 3H_{\Lambda} t \right\}$

Examples of equations related to Boltzmann brains used in the novel

Overview of the novel



Spanish version:

Published December 2018 in Buenos Aires by *Ediciones Ayarmanot*

Available for free download at:

<https://www.edicionesayarmanot.com/p/la-inevitable-resurreccion-de-los.html>

Launched at the Science Fiction Convention *Pórtico Córdoba 2019* and the *ExpoLibroSalta* Bookfair (both in Argentina)

English translation:

Currently in progress with the help of an *artsACT* grant. To be published under the title “Iridio Ennui vs the Boltzmann Brains”

Translation of the back cover

In the second half of the 22nd century, the catastrophes caused by climate change have far exceeded the dire predictions: a perennial economic crisis in the world; recurrent thermal waves; millions of refugees caused by increased sea levels and the extinction of the most common animals.

Iridio Geiser Perelman Ennui, anorgasmic, cryptorchidic, synesthetic and aromantic, has three obsessions: transcendental numbers, the real cause of the dinosaurs' extinction, and finding the centre of the universe, where the big bang originated. Iridio was raised by robotic nurses and instructors, who taught him that there is an equation for everything. Convinced of this, he confronts the post-creationists authorities of his university, the various police forces of the Popular Free-Market Republic of Ozeania, and the Reich-behaviourist psychometrists who attempt to normalise him, raising his indexes of genital eudaimonia.

In his innocent struggle to defend the pure sciences, Iridio would also confront the most virulent enemies of human progress: the fluctuating Boltzmann's brains, entities which spontaneously appeared in the quantum foam of sidereal space, who have taken control of the minds of authorities of the chaotic planet Earth and have contaminated their pineal glands.

I.1. Los tres primeros segundos

La mayor parte de las ideas fundamentales de la ciencia son esencialmente sencillas y, por regla general, pueden ser expresadas en un lenguaje comprensible para todos.

Albert Einstein

Subsection
quote

Iridio Géiser Pérezman Ennui parecía destinado a hacer grandes cosas. El día de su nacimiento es considerado por los historiadores solares como la fecha en que empezó a revertirse la persistente Regresión Tecnológica que caracterizó el planeta Tierra a partir de la segunda mitad del siglo XXI, un doloroso período conocido de manera informal como “La Penumbra”. Ese día coincidió con una extensa lluvia que rompió, por primera vez en el siglo XXII, la sequía que había azotado el oeste del Océano Pacífico en un evento El Niño extendido, y se reestablecieron los monzones en Eurasia Central. Además, la mano invisible del mercado produjo por primera vez en casi veinte años un superávit en la bolsa de Bandar-Austro-Metrópolis, la capital de su país natal, la República

Popular Libremercadista de Ozeanía. La tendencia ascendente se contagió por unos meses a las otras bolsas en el sector terrestre del planeta, y despertó

la primera esperanza de que el estancamiento económico y social que había caracterizado los decenios precedentes se atenuara.

Proper
equation

$$\frac{\partial V}{\partial t} + \frac{1}{2} \sigma^2 S^2 \frac{\partial^2 V}{\partial S^2} + rS \frac{\partial V}{\partial S} - rV = 0$$

1.1.i. La ecuación de Black-Scholes

Sus padres habían signado su destino dándole esos nombres que lo hacían en verdad único, pero al mismo tiempo provocaban burla entre sus conocidos, compañeros y colegas. De acuerdo con la tradición, el primer nombre había sido elegido por su madre, la Dra. Eleanor Linda Montag Pérezman. Eleanor era una física teórica que dedicó la mitad de su vida a escudriñar las ecuaciones de la teoría de cuerdas heteróticas E. Sin embargo, debido a sus frecuentes conflictos con las autoridades de la universidad Go8-Ivy-BAM, donde trabajaba, había sido disuadida de dilucidar problemas teóricos, y reasignada a un departamento de educación. Allí ayudaba a los alumnos que tenían problemas para entender los conceptos científicos elementales en los cursos de nivelación obligatorios enseñados por los instructores automáticos robomucs. De vez en

Definition →

«H quiso decir algo mediante x» es verdadero si, y sólo si (para algún A y para alguna r):

- a) H profirió x con la intención de que:
- (1) A llevase a cabo r,
 - (2) A pensara que H tenía la intención (1),
 - (3) la satisfacción por A de (1) se basa en la satisfacción por A de (2).
- b) No existe ningún elemento de inferencia E tal que H profiriese x con la intención tanto (1') de que la determinación de r por parte de A contara con E, como (2') que A pensara que H tenía la intención de que (1') fuese falsa.

1.7.vi. Redefinición II, versión B del significado ocasional del hablante, según H. P. Grice

Digital expansion of transcendental & irrational numbers

tenía problemas en el futuro. Antes de morir, Salvatore le entregó su largamente pergeñado poema dentro de un sobre cerrado, y le hizo prometer que lo abriría recién cuando hubiera logrado calcular con certeza la ubicación de ese mítico lugar. Una vez que Iridio guardó el sobre, empezaron a recitar juntos, con la ayuda de Halina, la expansión digital de la razón áurea. Por desgracia, no llegaron muy lejos: 1, ., 6, 1, 8, 0, 3, 3, 9, 8, 8, 7, 4, 9, 8, 9, 4, 8, 4, 8, 2, 0, 4, 5, 8, 6, 8, 3, 4, 3, 6, 5, 6, 3, 8, 1, 1, 7, 7, 2, 0, 3, 0, 9, 1, 7, 9, 8, 0, 5, 7, 6, 2, 8, 6, 2, 1, 3, 5, 4, 4, 8, 6, 2, 2, 7, 0, 5, 2, 6, 0, 4, 6, 2, 8, 1, 8, 9, 0, 2, 4, 4, 9, 7, 0, 7, 2, 0, 7, 2, 0, 4, 1, 8, 9, 3, 9, 1, 1, 3, 7, 4, 8, 4, 7, 5...

Al enterarse de la muerte de Salvatore, la Dra. Charrington der Heer ordenó una autopsia reglamentaria, y por fin pudo volver a trabajar en la corrección de su artículo. Seis días más tarde, el día después de que enterró a su padre en el modesto cementerio de Widgeree, logró, gracias a la intervención de Ernesto, quien también lo acompañó en el funeral, que el comité asesor de una revista de astronomía de quinta categoría publicada por la Universidad de Waikikamukau, que necesitaba contribuciones para poder justificar su existencia, aceptara leer su trabajo. Ernesto le prometió que hablaría con el licenciado Artem Reza Kumar Aliyev, el editor, a quien conocía, para que hiciera progresar su artículo en proceso de referato. Se ofreció, además, a ayudar a los revisores con la interpretación de las matemáticas del artículo, si así lo requerían.

Zoe y la señora Frau Grubach asistieron al entierro, y en determinado momento, cuando Zoe hablaba con Ernesto, la señora Frau Grubach

picamente las máximas de Grice, mintiéndole sobre la muerte de sus abuelos, había ahí algo que no cuadraba. Su padre también habló varias veces de la emulación mental, y de los cerebelos cuánticos, y de que había llenado varios formularios en el multilegalífero, por si él

en donde no podían estar en la misma habitación juntos por la frustración de Iridio, que no había podido superar todavía la separación de Penélope y agredía a su madre, le pedían ayuda a Ernesto, quien tenía más paciencia para explicarle cómo narrar lo esencial de las ecuaciones, y escuchar las nuevas interpretaciones que Iridio proponía después de estudiar una y otra vez los mismos postulados.

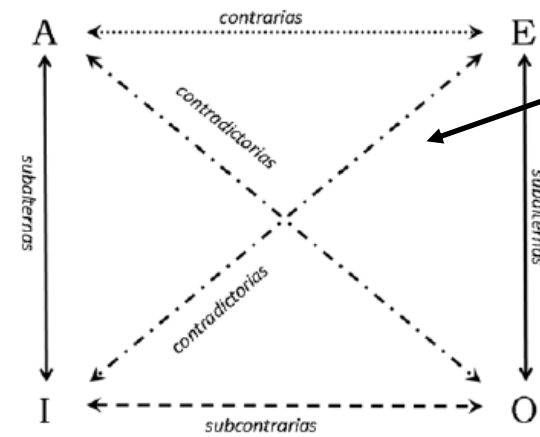
Un gran incentivo para perseverar fue que, a pesar de que las había estudiado antes en el colegio, entendió por primera vez las leyes de Newton,

Table (with definitions and equations) →

Nombre	Descripción	Fórmulas
Primera ley o Ley de Inercia	Todo cuerpo permanece en su estado de reposo o de movimiento rectilíneo uniforme a menos que otros cuerpos actúen sobre él.	$\vec{p} = m \vec{v}$ Con $V=0$ o $V=constante$
Segunda ley o Principio Fundamental de la Dinámica	La fuerza que actúa sobre un cuerpo es directamente proporcional a su aceleración.	$\vec{F} = \frac{d\vec{p}}{dt} = m\vec{a}$
Tercera ley o Principio de acción-reacción	Cuando un cuerpo ejerce una fuerza sobre otro, éste ejerce sobre el primero una fuerza igual y de sentido opuesto.	$F_{12} = -F_{21}$
Ley de la Gravitación Universal	Toda partícula de materia atrae a otra cualquiera con una fuerza proporcional al producto de las masas de las partículas e inversamente proporcional al cuadrado de las distancias entre ellas, dirigida a lo largo de la línea recta que las une.	$F = G \frac{m_1 m_2}{r^2},$ $G = 6.67 \times 10^{-11}$

1.1.vii. Las leyes de Newton

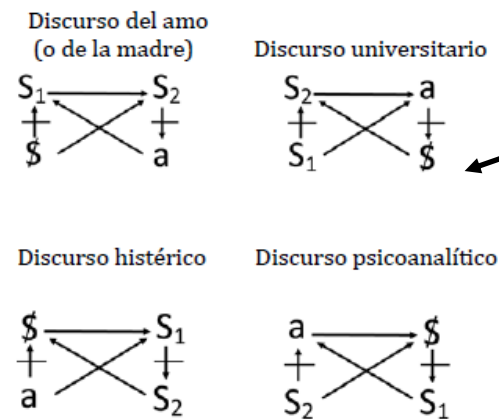
que ellos consideraban como la base del maltrato a los animales y la destrucción del medio ambiente, pero sobre la que él, interesado sólo en



A = Universal Afirmativo (Todo S es P)
E = Universal Negativo (Ningún S es P)
I = Particular Afirmativo (Algún S es P)
O = Particular Negativo (Algún S no es P)

3.1.ii.b. El cuadrado de oposición de los juicios de Aristóteles-Boecio

pensar en término de dicotomías. Esta característica explicaba la ética considerarlo "matematizante" si usaba mucho esos conceptos. Le explicó los rudimentos de la teoría lacaniana de los cuatro discursos, para enfatizar que, si quería solucionar el problema del discurso de la universidad, primero debía solucionar el discurso de la histeria. Concluyó diciéndolo que lo que pensaba en realidad era que su problema se debía



1.3.iii.a. Los cuatro discursos según Lacan

Logical square

Table (with Lacanian mathemes)

$$||G_{\nu}^{\mu}|| = \begin{bmatrix} \frac{3}{4} \left(\frac{df}{dct} \right)^2 & 0 & 0 & 0 \\ 0 & -\frac{1}{4} \left(\frac{df}{dct} \right)^2 - 4f \frac{d^2 f}{dct^2} & 0 & 0 \\ 0 & 0 & -\frac{1}{4} \left(\frac{df}{dct} \right)^2 - 4f \frac{d^2 f}{dct^2} & 0 \\ 0 & 0 & 0 & -\frac{1}{4} \left(\frac{df}{dct} \right)^2 - 4f \frac{d^2 f}{dct^2} \end{bmatrix}$$

1.7.iv. El tensor de Einstein en la métrica de Robertson-Walker

Iridio corrió a buscar a su padre para avisarle que su madre había expirado. Su padre tuvo que calmarlo porque le parecía que el mundo se derrumbaba. Iridio le contó que su madre le había dado muchas ideas para su trabajo, y Salvatore, previendo que podría tener un ataque de pánico en cualquier momento, le recomendó que se concentrara en pensar en las consecuencias de la discusión para sus cálculos, en vez de la muerte de su madre y las repercusiones del evento para su futuro. Al llegar a la habitación descubrieron que dos enfermeras habían llegado, y le desconectaban a su madre los monitores de su actividad vital. Le habían puesto bol-

vaginal orgánicamente verdadera siguiendo sus consejos. El psicoanalista se alegró mucho, y lo hizo completar otra serie de análisis biológicos y tests psicológicos, en donde se evidenció que había más eyaculaciones que las que Iridio reportaba. Él le explicó que el evento había provocado una serie recu-

rrente de sueños húmedos en los que era obligado a hacer el amor con Clarisse o con Fanny que lo angustiaban mucho, como después de sus suicidios. La semana siguiente, en su próxima visita para saber los resultados, el licenciado Rieneke Watson le dijo que había comprobado con Julia que el intercambio de energía orgónica hubiera efectivamente tenido lugar, y que ahora podía poner en el informe oficial para

Sea $(X, \mathfrak{S}, \mu)$ un espacio de probabilidad, y $f: X \rightarrow X$ una transformación que preserve la medida.

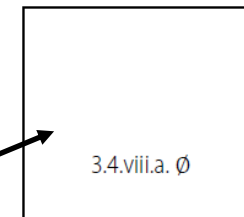
Si X es un espacio de Hausdorff que verifica el segundo axioma de numerabilidad, y $\mathfrak{S}$ contiene una σ -álgebra de Borel, entonces el conjunto de puntos recurrentes de f no tiene medida nula. Es decir, μ -casi todo punto de f es recurrente.

1.4.iv.c. Versión topológica del teorema de Recurrencia de Poincaré

Matrixes

Empty/nule
elements

1, 8, 6, 3, 0, 6, 7, 4, 4, 2, 7, 8, 6, 2, 2, 0, 3, 9, 1, 9, 4, 9, 4, 5, 0, 4, 7, 1, 2, 3, 7, 1, 3, 7, 8, 6, 9, 6, 0, 9, 5, 6, 3, 6, 4, 3, 7, 1, 9, 1, 7, 2, 8, 7, 4, 6, 7, 7, 6, 4, 6, 5, 7, 5, 7, 3, 9, 6, 2, 4, 1, 3, 8, 9, 0, 8, 6, 5, 8, 3, 2, 6, 4, 5, 9, 9, 5, 8, 1, 3, 3, 9, 0, 4, 7, 8, 0, 2, 7, 5, 9, 0, 0, 9, 9, 4, 6, 5, 7



El lanzamiento al espacio interestelar de la versión definitiva de su cuerpo derivado se hizo desde la galaxia enana de Sculptor, en los confines de la Vía Láctea, donde los zuespoks tenían una embajada. A pesar de la recomendación de los namoryaplokiyanos de que ya no los necesitaría, decidió conservar sus genitales.

Por fin conoció a los eelsmolianos. Vivían en un multiverso paralelo de 10 dimensiones con curvatura positiva, y él solamente pudo interactuar con ellos a través de otros extraterrestres, los naujmaldeceanos, que los representaban en el multiverso-L. Parecían inmensos, y estaban preocupados por las ecuaciones de estado que heredarían las burbujas que se desprenderían de este multiverso en un futuro distante. Lo trataron con una gran amabilidad, casi con ternura, y lo envolvieron en una coraza de magnetita, un material que le permitiría resistir presiones de hasta

Reich's
formulas

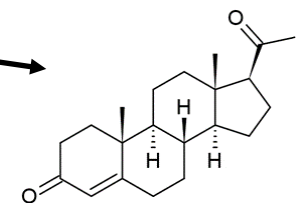
ción Social y Culto Digital, porque el segundo tenía un poder de fiscalización amplio que las otras dependencias estatales resentían.

Tensión Mecánica →
Carga Bioeléctrica →
Descarga Bioeléctrica →
Relajación Mecánica

1.4.vi.a. La fórmula del orgasmo de acuerdo a Wilhelm Reich

Con la excusa de prevenir que esas disputas ministeriales lo perjudicaran, Julia lo convenció de tener una relación sexual ininterrumpida con ella, tomando todo el tiempo que necesitaran. Organizaron una cena en la casa de Julia, en donde el tan postergado evento tuvo lugar.

Ambos se sorprendieron cuando, después de sólo tres horas y media de motivación orgónica ininterrumpida, logró llegar al clímax en la postura de la bestia bicéfala cuando ella le leía el teorema fundamental del cálculo, que le traía tantos buenos recuerdos de Penélope. Se sintió más aliviado después de ese momentáneo éxito, y se relajó del todo, durmiéndose en los brazos de Julia. Para Iridio, no fue nada del otro mundo, pero Julia parecía muy satisfecha con el resultado, ya que, antes de que ella le leyera el teorema, él no la interrumpió



Theorems

Chemical
formulas

bían dejado usar conexiones simultáneas con el aparato, porque la imagen de una mujer, que evidentemente lo miraba, ocupaba la pantalla. Primero pensó que era la Dra. Charrington der Heer, pero luego reconoció a una versión aún más joven que la que había visto antes de su abuela Mildred. Se preocupó porque eso auguraba que el procedimiento con el casco de las intervenciones le había provocado alucinaciones. Su abuela materna proyectó un mensaje

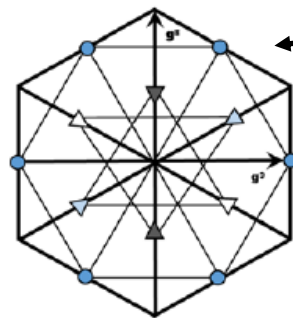
I. $\alpha F^1 \beta^2 \alpha^2 M C \uparrow M-N$
 $M-N W^0$
 II. $\beta^3 \eta^3 \theta^3 A^6$
 III. A^{11}
 IV. $F^6 \alpha^1 C \uparrow G^2 K^1 \downarrow Pr^4-Rs^1 W^0 n^6 g$
 V. $A^{18} B C D^9-E^9 K^4$
 II. $F^2 K^4 U$
 IV. W^0
 III. $C \uparrow F^2 K^4 W^2$

2.7.v.b. Análisis de un cuento con cinco secuencias, algunas de las cuales se entrelazan, de acuerdo a Vladimir Propp

en la pantalla, pidiéndole que se pusiera el casco de diagnóstico que la Dra. Johnson Xlof le había puesto antes. En el aparato al que estaba conectado el casco se sucedían los dígitos de π , a partir de la primera secuencia de Feynman. Cuando se puso el casco, su abuela le indicó que tocara un botón, cerca de su oreja izquierda. Entonces su imagen se proyectó a sus ojos con nitidez. Aparecieron varios códigos alfanuméricos superpuestos con la imagen que reconoció eran los dígitos

~ 256 ~

traterrestres, y la traducción de ellas a los conceptos científicos que antes le costaban tanto esfuerzo. Sin dificultad, podía traducir los conceptos matemáticos a hologramas abstractos usando un lenguaje visual desarrollado por los dranoelsusskindianos, unos seres en Lacaille 8760, casi todo ojos, que le habían sugerido utilizar en sus cálculos, y entender por qué era importante que las partículas subatómicas formaran una estructura de grupo matemático, contenida en el álgebra de Lie e_8 , y que el espa-



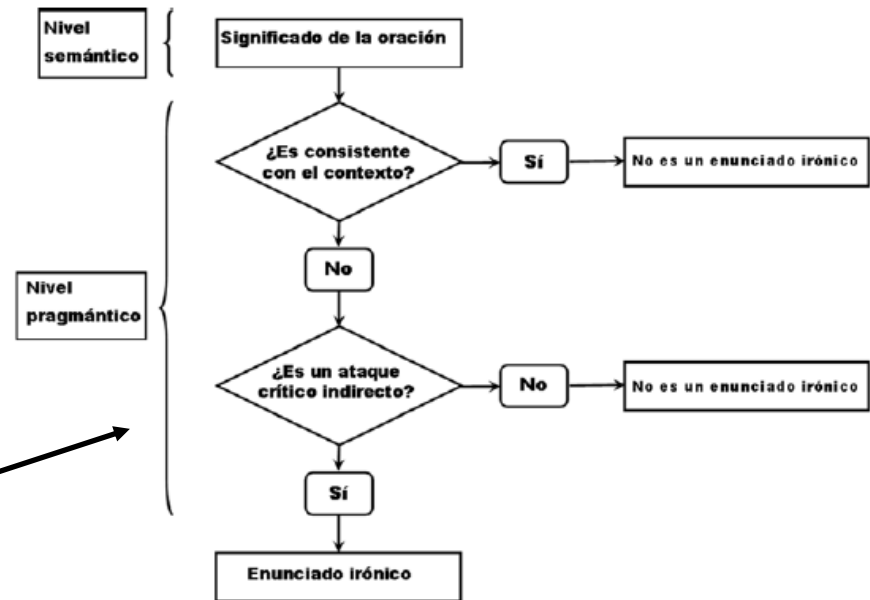
3.4.i.b. Representación gráfica del campo de color de dimensión 8 de $su(3)$ y los valores propios de gluones, quarks y anti-quarks, según A. G. Lisi

~ 328 ~

Scientific graph

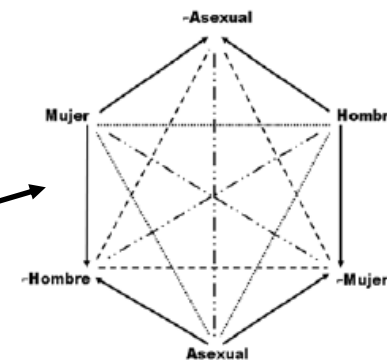
Logical hexagon

La inevitable resurrección de los cerebros de Boltzmann ✦ Mario Daniel Martín



3.4.v.b. Diagrama de flujo para la identificación de los enunciados irónicos, según Osorio y Uchima

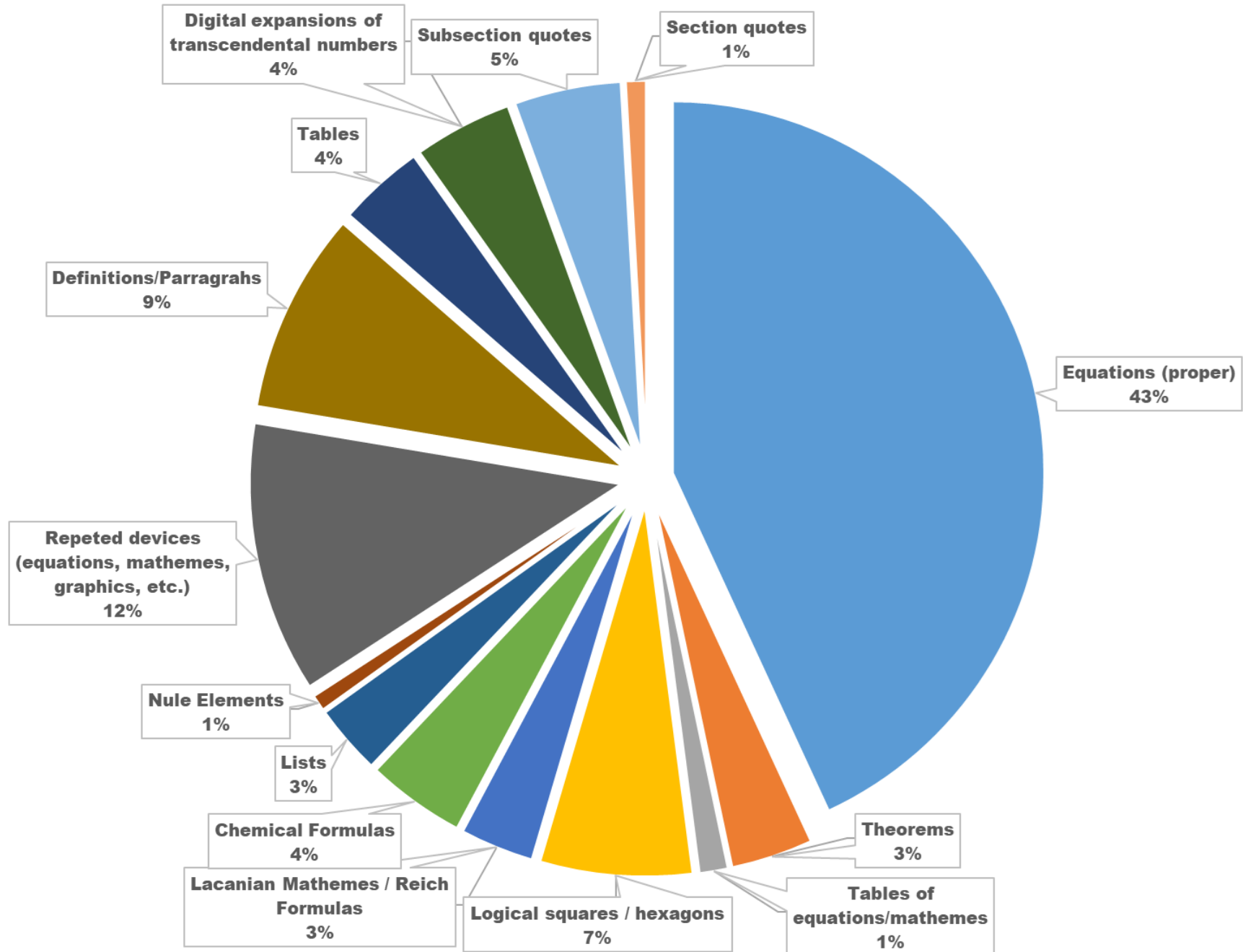
terna y su tío le pareció abominable, y por fin comprendió la tragedia de sus abuelos, y por qué había tenido tantos escollos en su vida. Había tantas coincidencias para explorar, y también necesitaba comprender la influencia de su tío en las inteligencias artificiales que lo habían acompañado en su desarrollo social. Asimismo, entendió las razones verdaderas por las que Zoe lo había protegido tanto en la oficina de patentes. Además de compartir con él la cadena de discriminaciones debida a ser hija de disi-



3.4.v.c. El hexágono de las oposiciones en la sexualidad, según Moretti

~ 342 ~

All Extratextual devices



Overview of the novel sections

Section 1. Residence on Earth

Parody of classical dystopian novels and scientists' biographies

Section 2. Galactic Influences

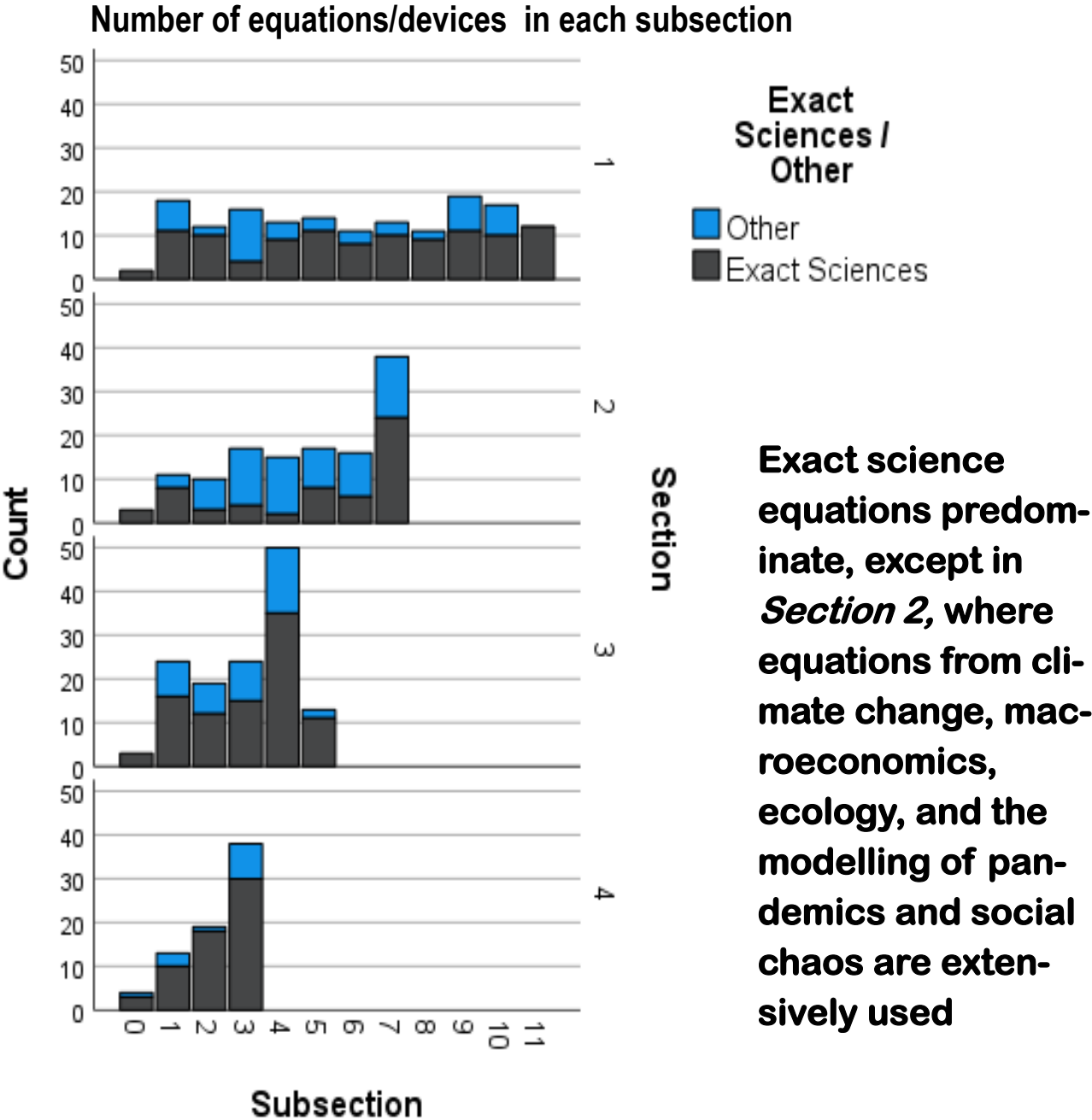
Parody of first contact novels and cli-fi novels

Section 3. Interplanetary Host

Parody of novels featuring visits to other planets and virtual reality plots

Section 4. The last galaxy fading away

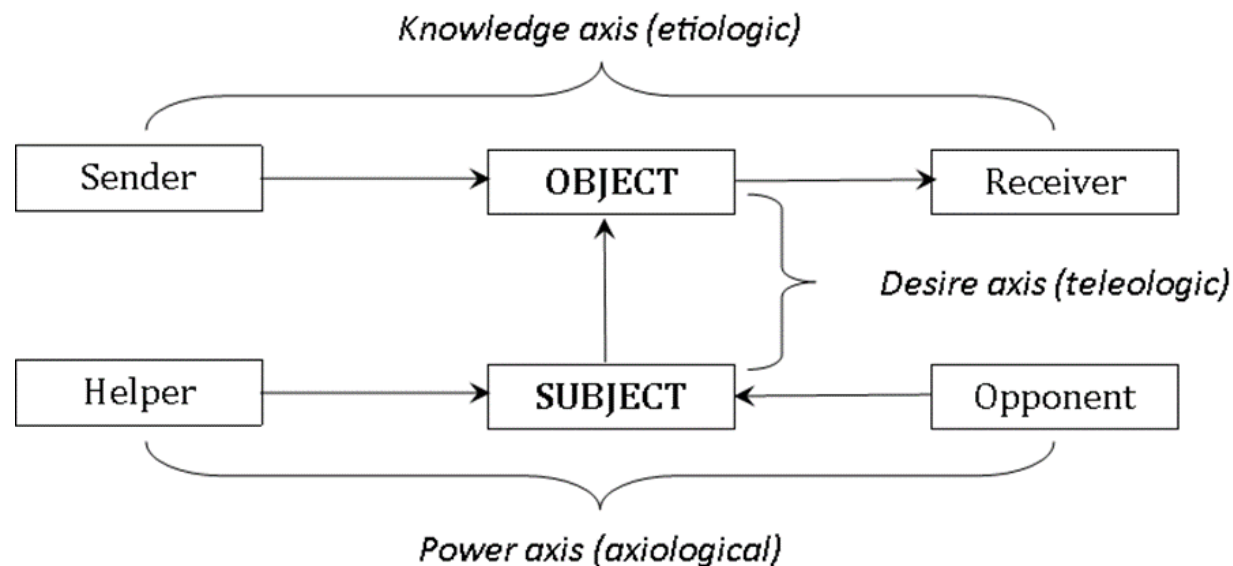
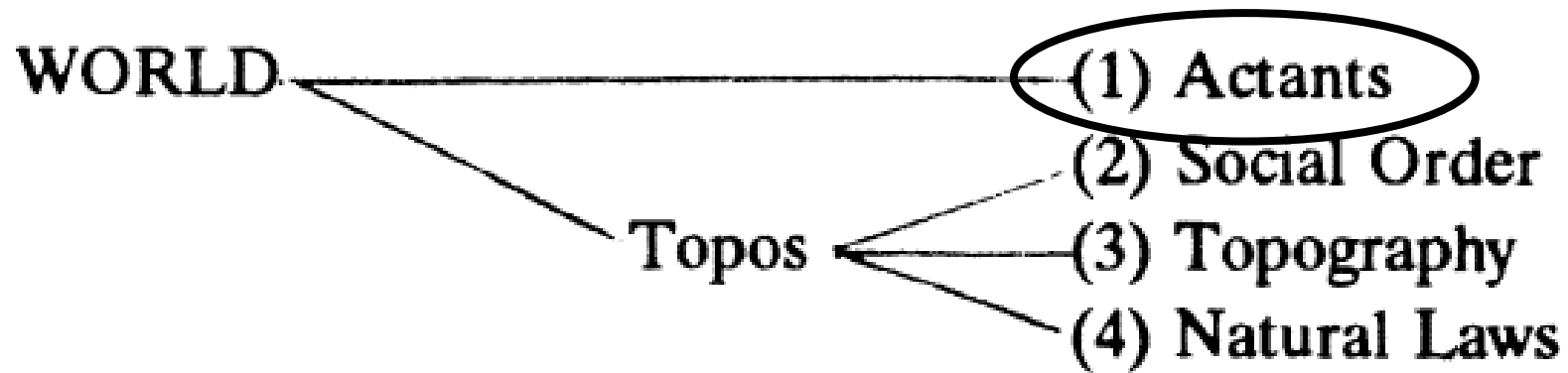
Surrealist/absurdist "grand finale"

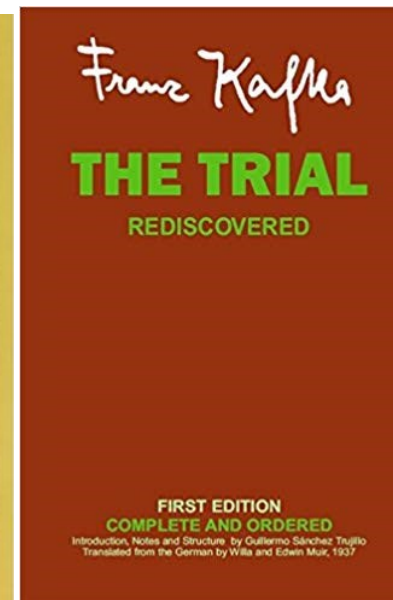
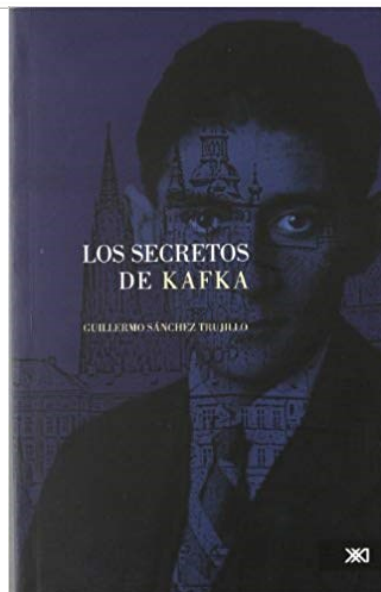
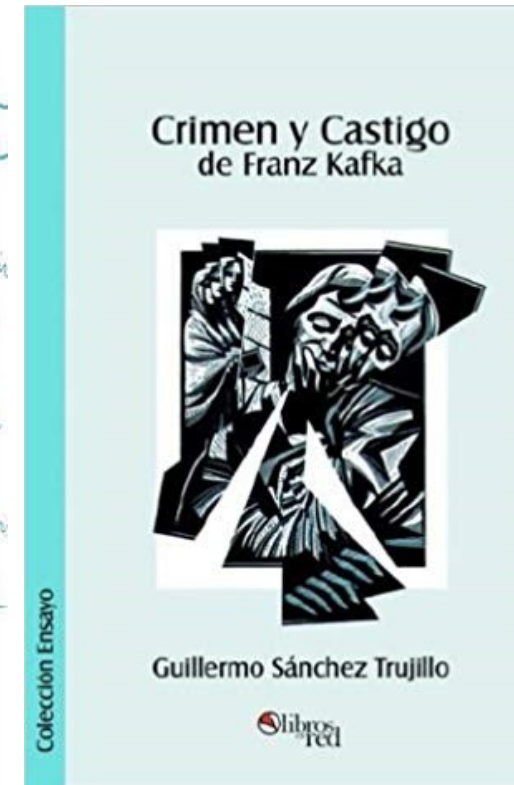
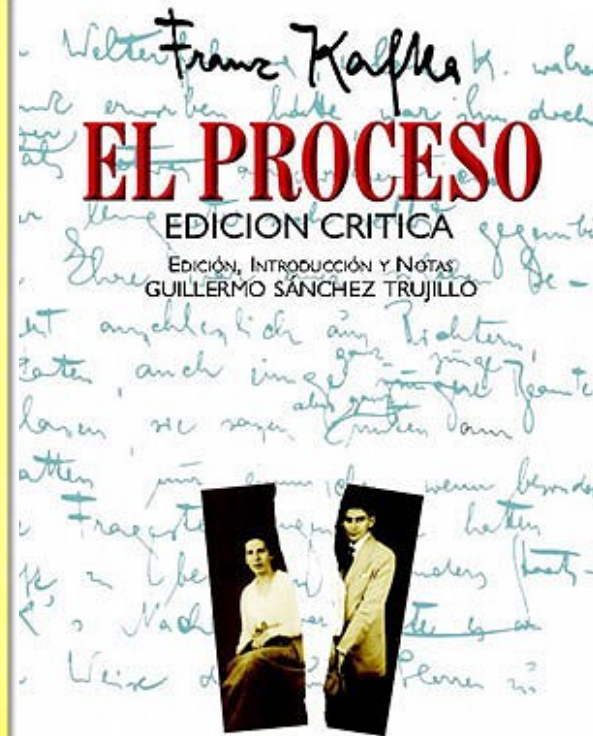


Exact science equations predominate, except in *Section 2*, where equations from climate change, macroeconomics, ecology, and the modelling of pandemics and social chaos are extensively used

Includes repeated devices

The Actants



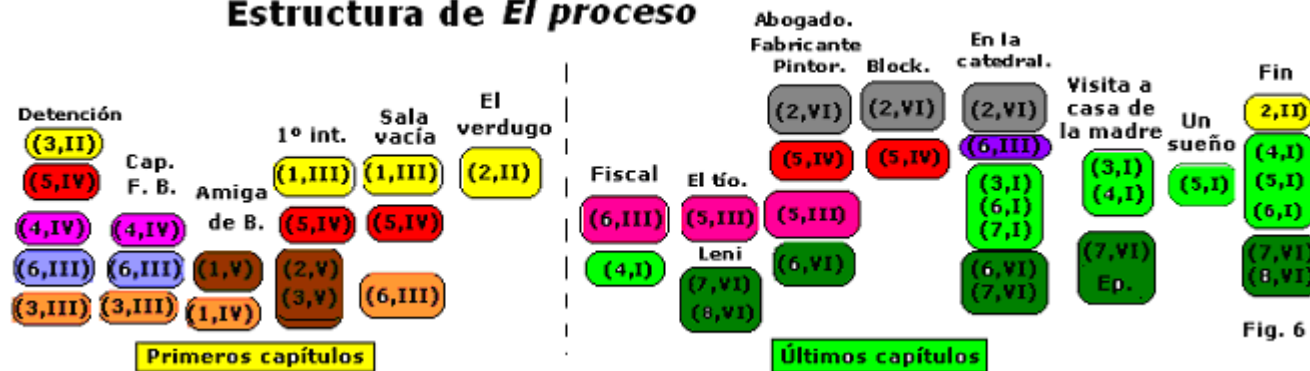


The main influence on how to develop the novel's actants come from Guillermo Sanchez Trujillo's work.

Sanchez Trujillo translated Kafka's *The Trial* into Spanish, and looked for a way to order the unfinished manuscript

Kafka not only had left *The Trial* unfinished, but also he left different chapters in envelopes, without a clear ordering. Max Brod published the novel presenting a main sequence, and the unordered chapters in an appendix. Later, several orderings were proposed, but Reiner Stach, the most important literary critic on Kafka's work declared the problem "unsolvable".

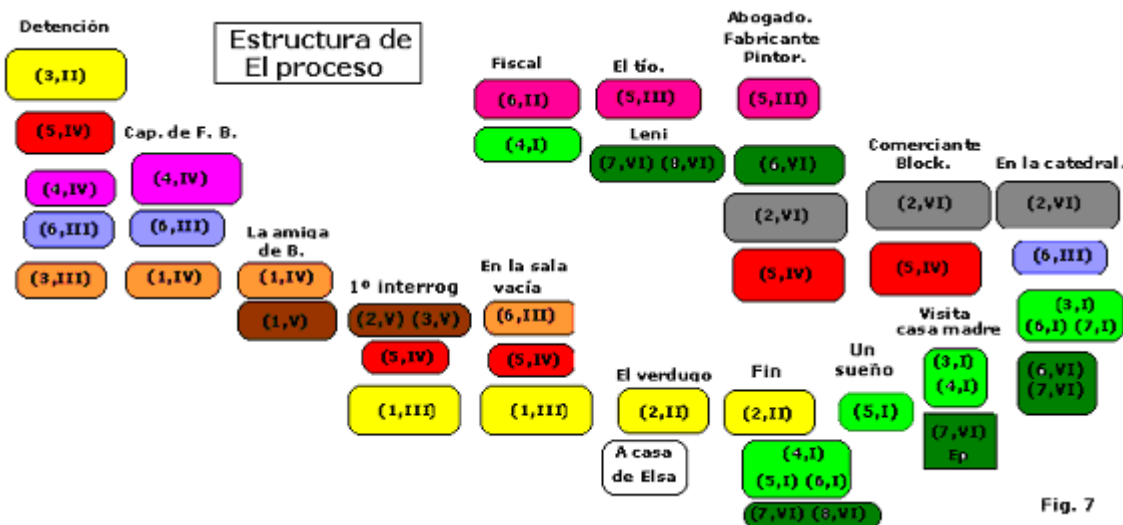
Estructura de *El proceso*

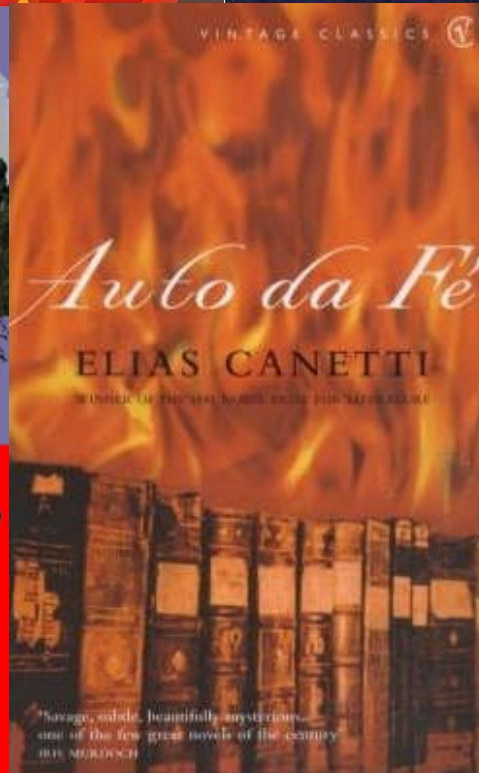
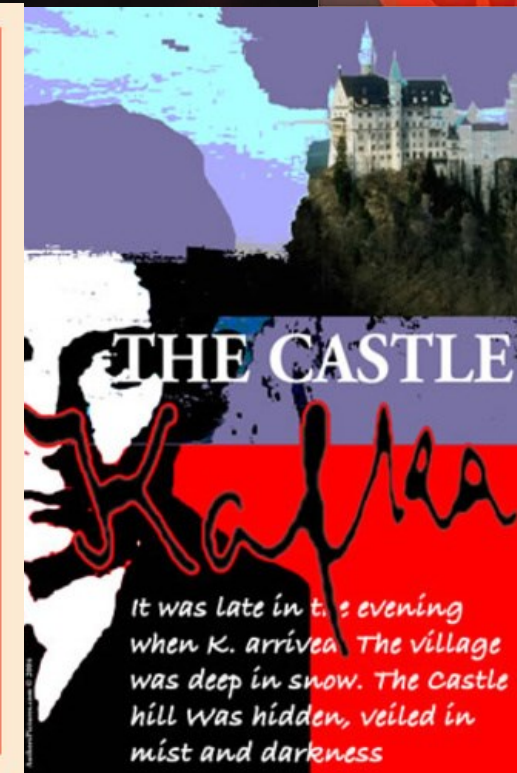
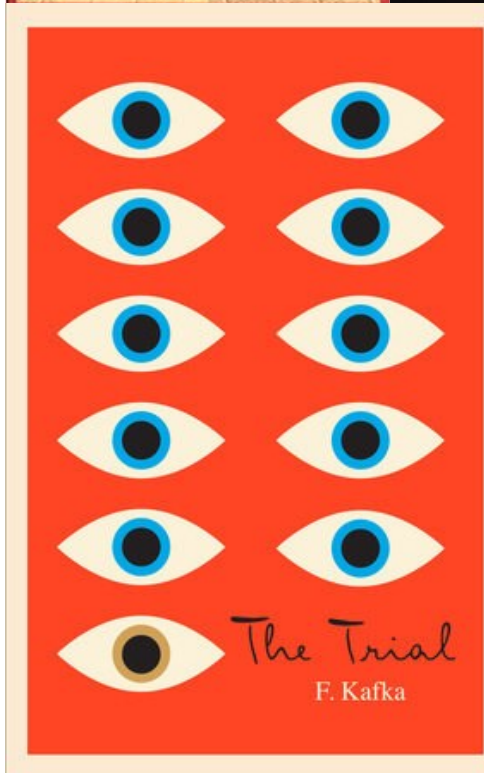
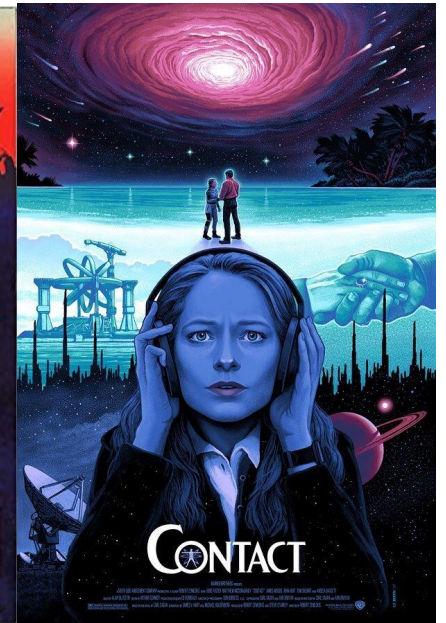
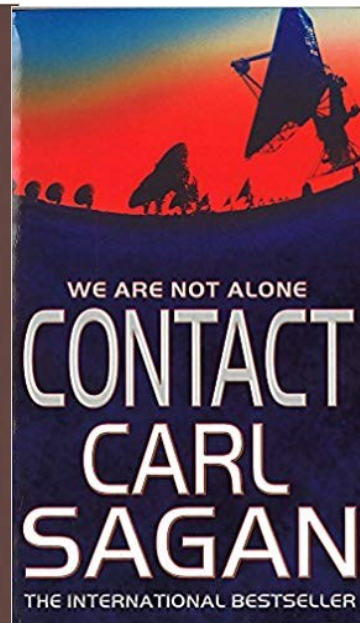
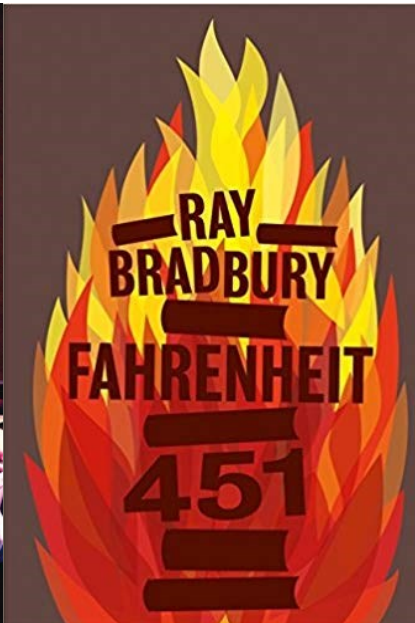
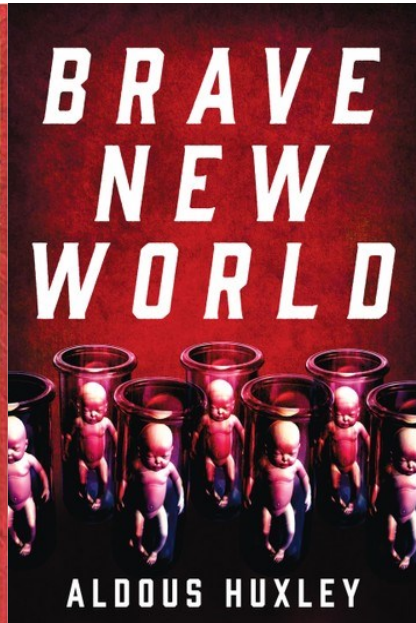
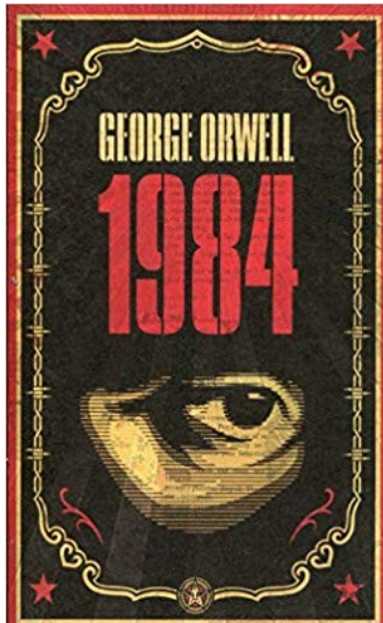


Sánchez Trujillo claims that he found the key to order the different sections of *The Trial* by making parallels with the text of Dostoevsky's *Crime and Punishment*.

He found that Kafka copied the structure of Dostoevsky's plot to structure *The Trial*. This was not plagiarising, but creating an "homology" of the actions of the characters.

He also found other works on which Kafka based the homology. For instance, the chapter on The Cathedral was based on Goethe's account of a trip to Italy.





Inspired on the procedure that Kafka supposedly used in *The Trial*, I used several novels to create the actants of my novel.

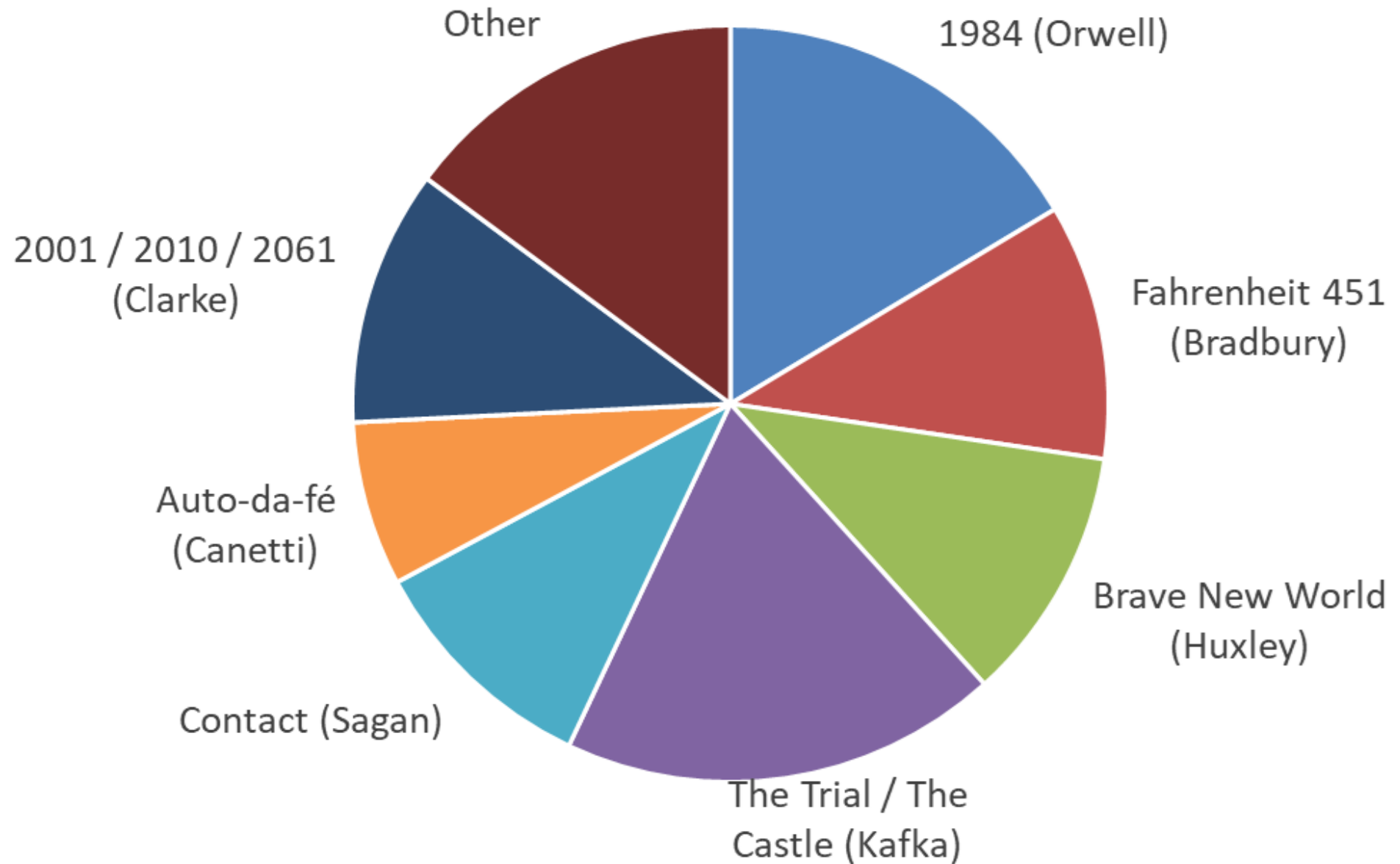
I formalised the vague Kafkaesque homological method using a multi-dimensional version of Greimas' actantial model

Each of the characters (except robots, cyborgs and extra-terrestrials) have four names, which point to (and inform) their actantial properties

	First Name	Second Name	First Surname (Maternal)	Second Surname (Paternal)
Names / Surnames	<i>Eleanor</i>	<i>Linda</i>	<i>Montag</i>	<i>Pérezman</i>
Source	Contact	Brave New World	Fahrenheit 451	<i>Other: Real name modified (science)</i>

	First Name	Second Name	First Surname (Maternal)	Second Surname (Paternal)
Names / Surnames	<i>Leni</i>	<i>Lenina</i>	<i>Huld</i>	<i>Pfaff</i>
Source	The Trial	Brave New World	The Trial	Auto-da-Fé

Names / Surnames of Characters



The use of Greimas' actantial model allowed for a reframing of Malmgren's concept of "science fantasy"

"It is also interesting to note that *many hybridized science-fantasy novels adhere to the traditional Romance archetype*, perhaps because of the natural affinity between their respective worlds.

For one thing, *the fantasy actants of hybridized science fantasy presuppose a "world elsewhere," a marvelous or exotic topos in which one or more constraints of empirical reality or scientific necessity are suspended.*

In this world, the protagonist is endowed with certain counternatural powers or attributes, which give his or her adventures a larger-than-life quality. And *those adventures frequently involve some sort of quest, either for a clearly defined object of desire or for the restoration of a shattered equilibrium.*

Most important, the recourse to *fantasy allows the fictionist to stage the story in a universe invested with value, as opposed to the value-neutral universe of SF"*

Source: Malmgren (1988) "Towards a Definition of Science Fantasy". *Science Fiction Studies*, Vol. 15, No. 3 (Nov., 1988), pp. 259-281

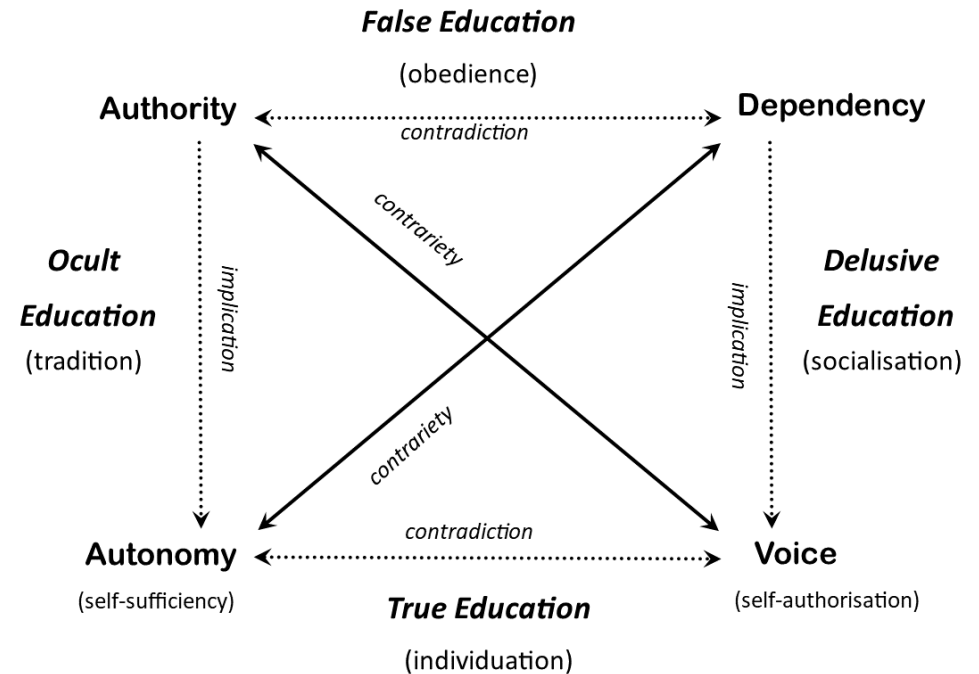
Examples of metareferential devices used in the novel

If in the first act you have hung a loaded shotgun on the wall, then in the following one it should be fired.

1.1.vi.a. Chekhov's dramatic foreshadowing principle

Propp	Greimas
Hero	Subject
<i>Princess (Sought for Person (and her father))</i>	<i>Object</i>
Donor (provider)	Helper
Dispatcher (father)	Sender/Receiver
Helper	Helper
Villain or Aggressor	Opponent
Traitor or False Hero	Opponent

2.6.vi.c. A comparison of the 'actant roles' of Propp and Greimas

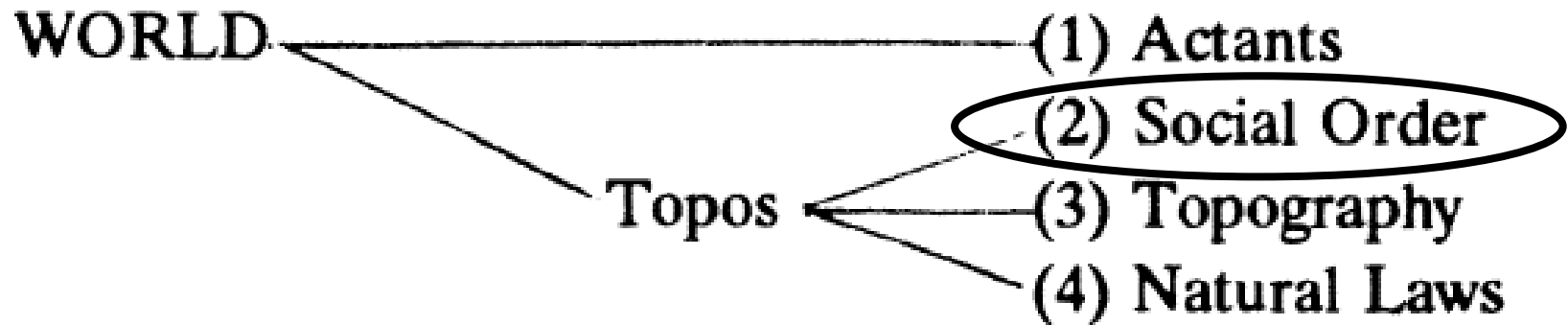


2.7.i.f. An application of the semiotic square to education

$$g_3(n) = \binom{2n-5}{n-2} + 2$$

A.ii. Kleitman and Pachter solution for Erdős's happy ending problem

The Social Order



$$\frac{dE}{dt} = f(A, G, I) \quad \text{since Earth formation until 1850}$$

$$\frac{dE}{dt} = f(A, G, I, H) \quad \text{between 1850 and 1950}$$

$$\frac{dE}{dt} = f(H) \quad \text{after 1950}$$

$$A, G, I \rightarrow 0$$

where A is astronomical forcing, G is geophysical forcing, I is internal dynamics of the Earth System (excluding human activity) and H human activity

$$S(\theta, \lambda, t) = \frac{\rho_i}{\gamma} G_s \otimes_i I + \frac{\rho_w}{\gamma} G_s \otimes_o S + S^E - \frac{\rho_i}{\gamma} \overline{G_s \otimes_i I} - \frac{\rho_w}{\gamma} \overline{G_o \otimes_o S}$$



International order:

- North America has imploded into theocracies (except, for a limited time in the Republic of California)
- Russia has invaded Europe and is now *Eurasia*
- China is divided into two: *The Third Popular Republic of North China* and *The Free-Market Republic of Taiwan-South China*
- All of the terrestrial zones of the planet are digital dictatorships which copied, to some extent, the model of citizenship social credits pioneered in 21st century China
- The internet has been dismantled, and replaced by “local information networks” controlled by the states
- Hydrocarbon multinationals have representatives in the governing bodies of all terrestrial states
- The only places where “liberal democracy” survives is in 1) floating cities, outside the 200 nautical miles territorial waters of terrestrial states and 2) scientific refuge zones (in the Vatican, North Atlantic and Antarctica) where traditional science can still be practiced



International order (continued):

- Space colonies and space farms provide more than half of the goods and food consumed on Earth, and the financing of the basic [universal minimum salary](#) to which citizens with enough social credit have access to.
- There is a control of science by the state and post-creationist churches. Investment in scientific research declined severely as a consequence of climate change disasters. The open sharing of scientific results has been halted
- Talking about climate change is forbidden (in spite of its obvious consequences affecting everyone). Books are burned to generate electricity.
- Climate activism is equated with “terrorism”, and in fact there are armed groups defending nature reserves. There are several ones: *The Ecological Brigades* is the most important
- Underground millenarian groups try to convince the population to commit suicide to protect non-human species, the most important is the MVEHS, the clandestine *Movement for the Voluntary Extinction of the Human Species*
- Eugenic laws allow for the extermination of disabled people and the castration of those with “undesirable genes”. Biological weapons are used to exterminate “Muslim genes”
- Cities are growing in Antarctica, as the continent ice recedes to the centre.



Local order:

- Australia invaded New Zealand and Pacific Islands which did not sink into the raising waters
- It is now called the *Popular Free-market Republic of Ozeania*
- Ozeania depends technologically on other terrestrial hegemonies, and systematically copies the worst social developments in other terrestrial powers
- Automatization of routine work created thousands of unemployed people
- There are several police forces, one for each government ministry. More than 30% of Ozeania's inhabitants work for the police forces, either as officers or informers, to supplement their universal minimum salary income
- Climate refugees boats are sank at sea by the Ozeanic navy
- The level of interference in science is similar to the one which the humanities are currently experiencing in Australia
- People cannot own pets because in the cities they die because of the thermal waves
- Koalas and other iconic animals only survive in reserves in the Blue Mountains. There are however, many pests (especially camels), and some mutated kangaroos and killer wombats



All the characteristics described above are responses to “what if?” questions

"Perhaps the crispest definition is that science fiction is a literature of 'what if?' What if we could travel in time? What if we were living on other planets? What if we made contact with alien races? And so on. The starting point is that the writer supposes things are different from how we know them to be."

Source: Evans, Christopher (1988). *Writing Science Fiction*. London: A & C Black, page 9

Also, models dealing with the semantics of fictional worlds (Marie-Lauren Ryan, Doležel, Eco, Pavel,) have been used

Doležel, L. (1998) *Heterocosmica: Fiction and possible worlds*. Baltimore: Johns Hopkins University Press.

Eco, Umberto (1984) *The Role of the Reader: Explorations in the Semiotics of Texts*. Bloomington: Indiana University Press.

Pavel, Thomas (1986) *Fictional Worlds*. Cambridge, MA: Harvard University Press.

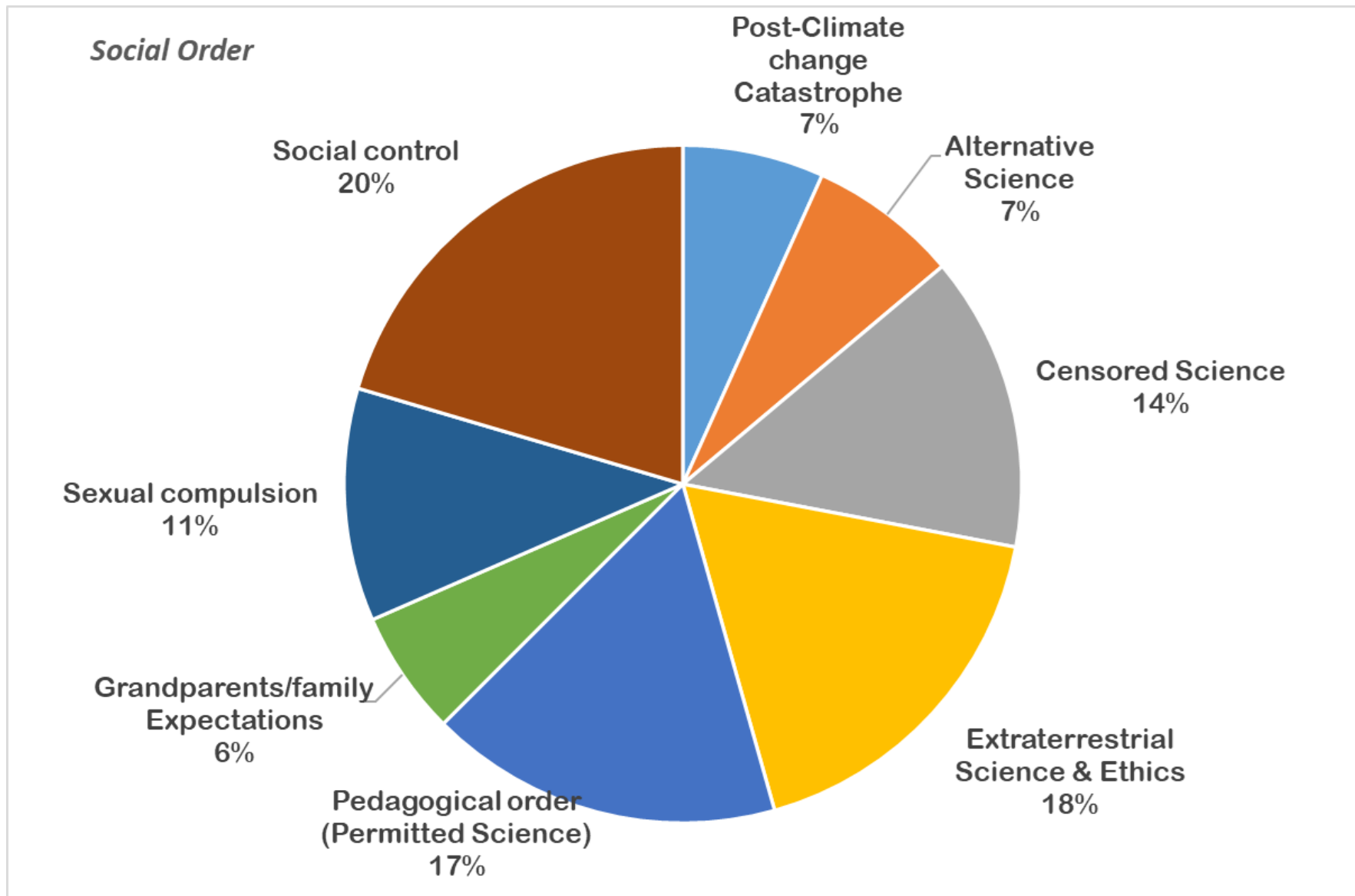
Ryan, Marie-Laure (1985) The Modal Structure of Narrative Universes. *Poetics Today*, Vol. 6, No. 4: 717-755

Ryan, Marie-Laure (2006) From Parallel Universes to Possible Worlds: Ontological Pluralism in Physics, Narratology, and Narrative. *Poetics Today* 27:4: 633-673.

Ryan, Marie-Laure (2007) Diagramming narrative. *Semiotica* 165–1/4: 11–40

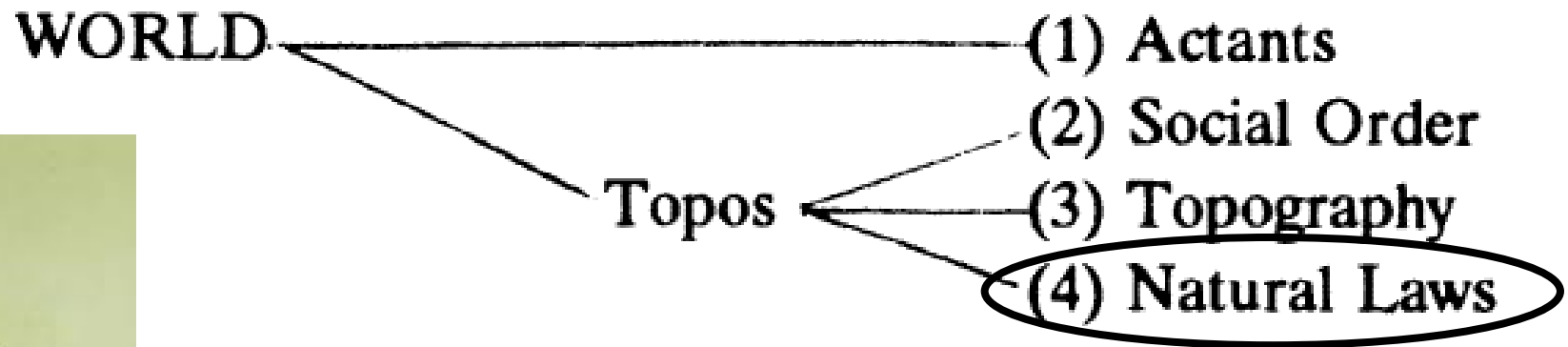
Ryan, Marie-Laure (2009) Temporal Paradoxes in Narrative. *Style*; Summer 2009; 43, 2: 142-164.

Ryan, Marie-Laure (2018) What are characters made of? Textual, philosophical and “world” approaches to character ontology. *Neohelicon* 45: 415–429.



Classification of the equations and other devices according to an adapted typology based on Malgrem's concept of social order

The Natural Laws



Let (X, P, μ) be a probability space and let T be an automorphism. If A belong to P , then μ -almost every point in A returns in finite times to A . In fact, almost every point returns infinitely often; i.e.

$$\bar{A} = \{x \in A : T^n(x) \in A \text{ for infinite } n > 0\}$$

and then $\mu(A \setminus \bar{A}) = 0$



Actants, social system, and topography all presuppose a system of natural laws, which in general remain consistent and universal in all science fiction proper. The final form of estrangement, involving as it does the universal natural laws which subtend science fiction in general and the assumptions informing the genre's discourse, results in an "impure" form called *science fantasy*.

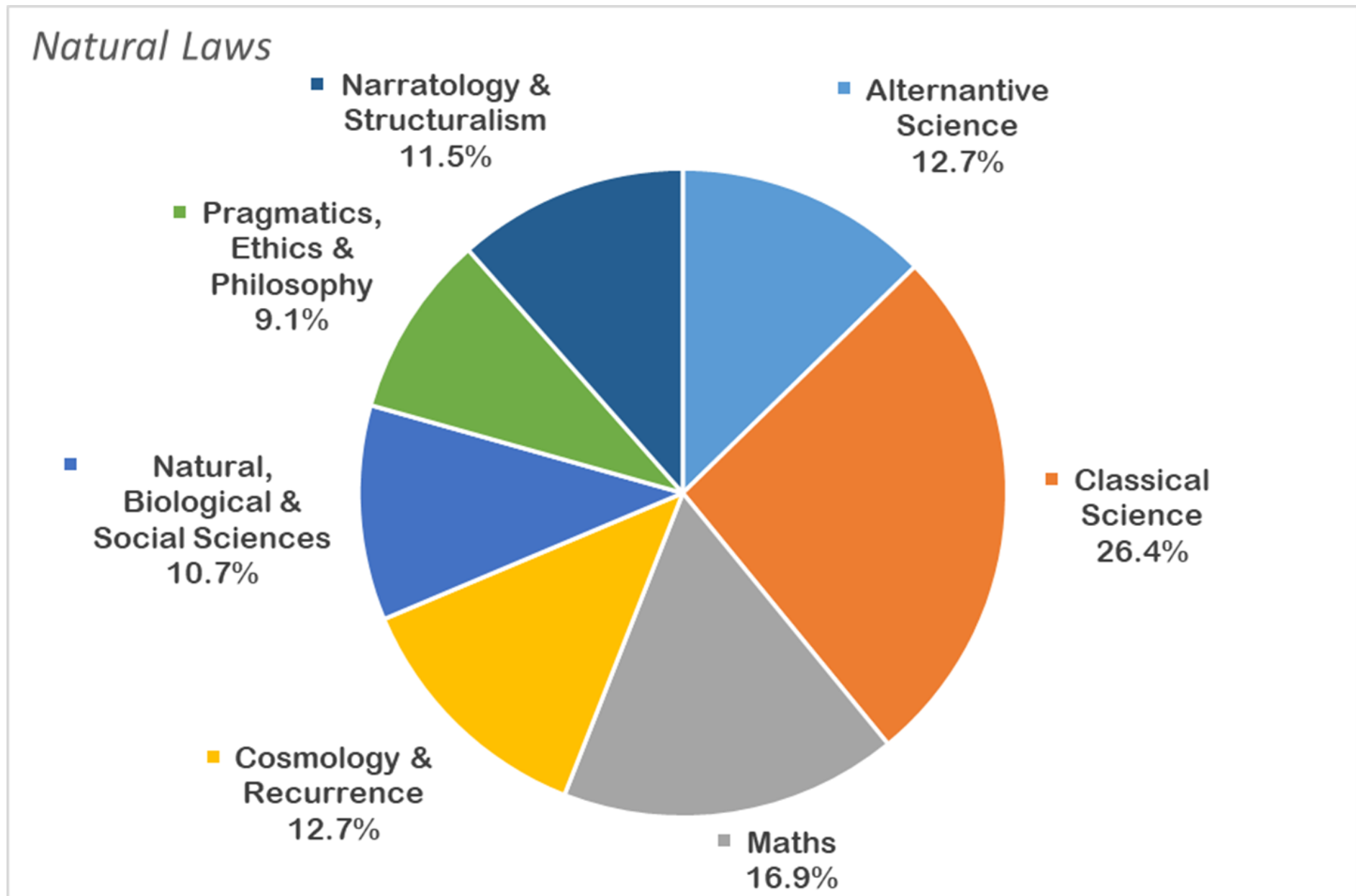
Source: Malmgren (1991) page 142

The novel challenges Malmgren's reductive conception of *science fantasy*, as natural laws are based on scientific results, and topics discussed in "serious" scientific papers.

The first and most obvious one is that uses Boltzmann brains as characters. They are very close to what could be considered "fantasy," but are "entities" discussed in scientific journals. In the novel they are introduced by intradiegetic narrators (the extraterrestrials).

The second, and maybe the most important one, is that the novel also reformulates a common trope in science fiction, *time loops (and time travel)* but justifies their use in the plot via the *Poincaré Recurrence Theorem*, a scientific result which resembles Nietzsche's *eternal return*. Recurrence gives time loops another "turn of the screw".

There are other examples of "apparent science fantasy" resources, all following the same pattern, they are based on "counterintuitive" scientific facts (like research on autism and human cognition and recent developments in the study of "universal logic").



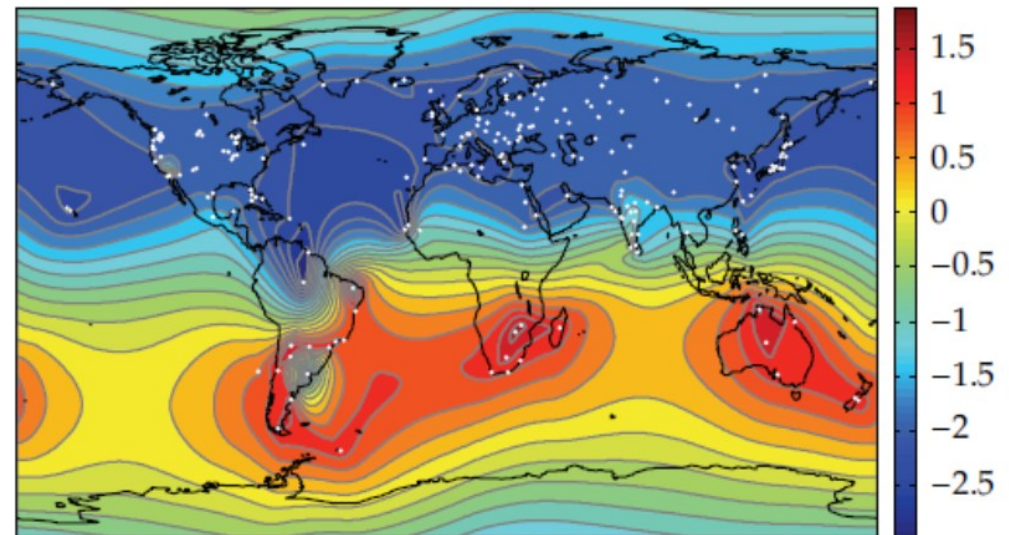
Classification of the equations and other devices according to an adapted typology based on Malgrem's concept of natural laws

There is, in addition, a reworking of the scientific cannon as a consequence of extensive censorship. A “sociology of science” is used in the worldbuilding, following Georges Canguilhem’s notion that science is affected by its environment, it “spontaneously makes and remakes its own history at every instant”.

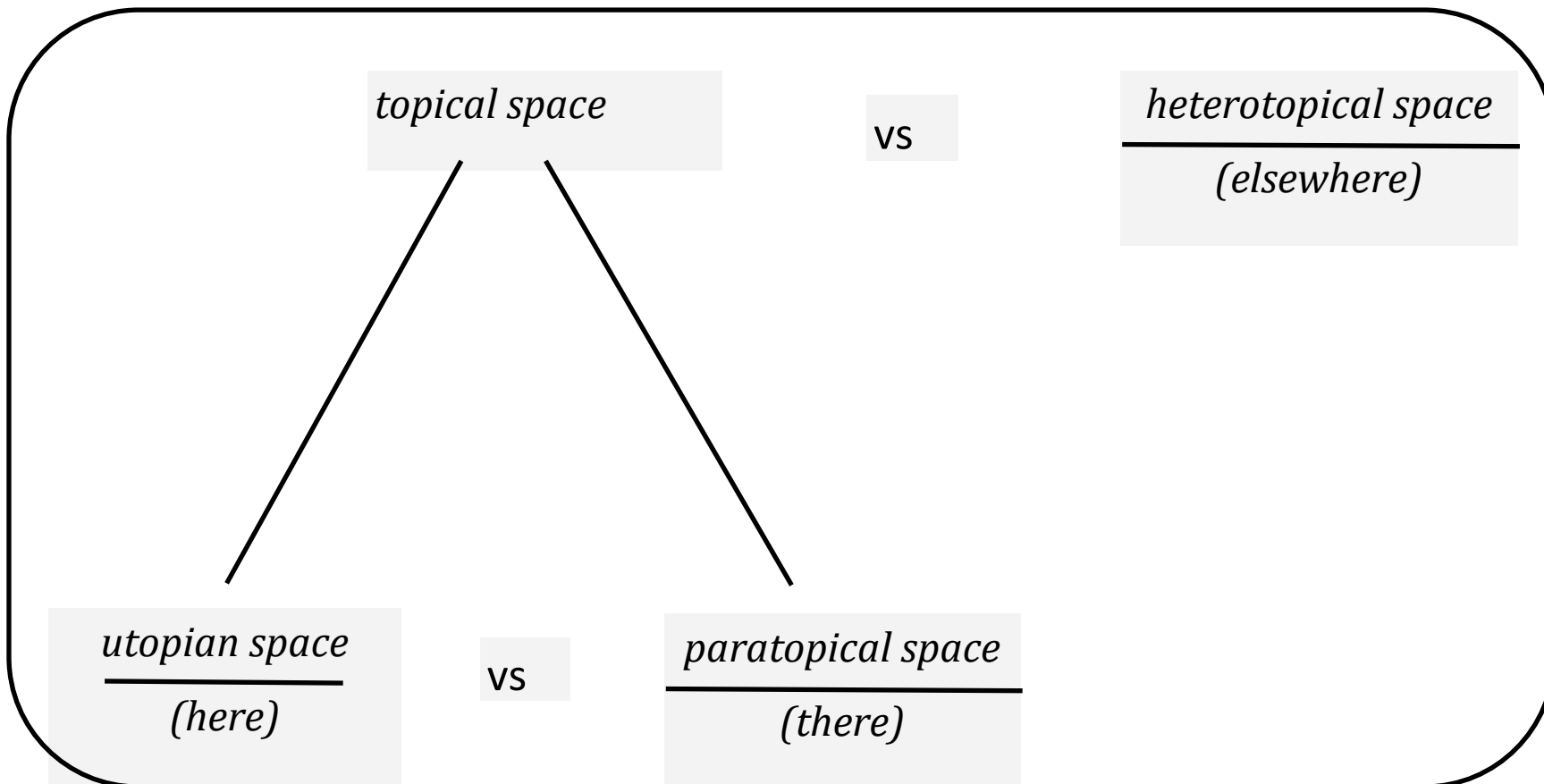
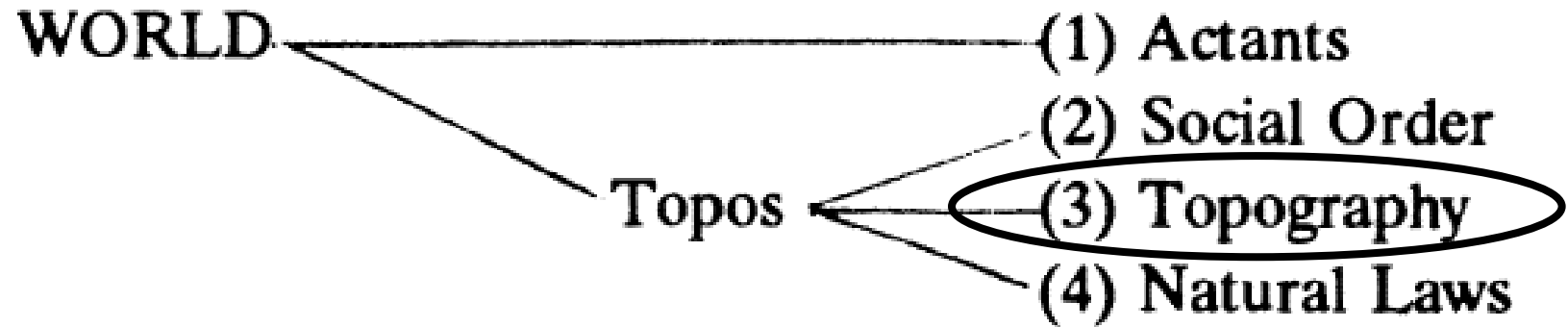
For instance, string theory, the most popular approach to theoretical physics today, has been declared “mathematicing” (prohibited because it relies too heavily on abstract mathematical concepts), and as global warming research, is considered a “heresy”.

In similar fashion, Ludwig Boltzmann has been erased from the new cannon (to avoid discussions about the Boltzmann brains), but also about other scientific facts that have been censored.

The presence of equations, often contradicting the text, also serve a symbolic function of demystifying the messages of corrupt authorities and Boltzmann brains, when the denialism of scientific facts so current in our century is extrapolated towards its more absurdist limit in a dystopian 2184 setting.



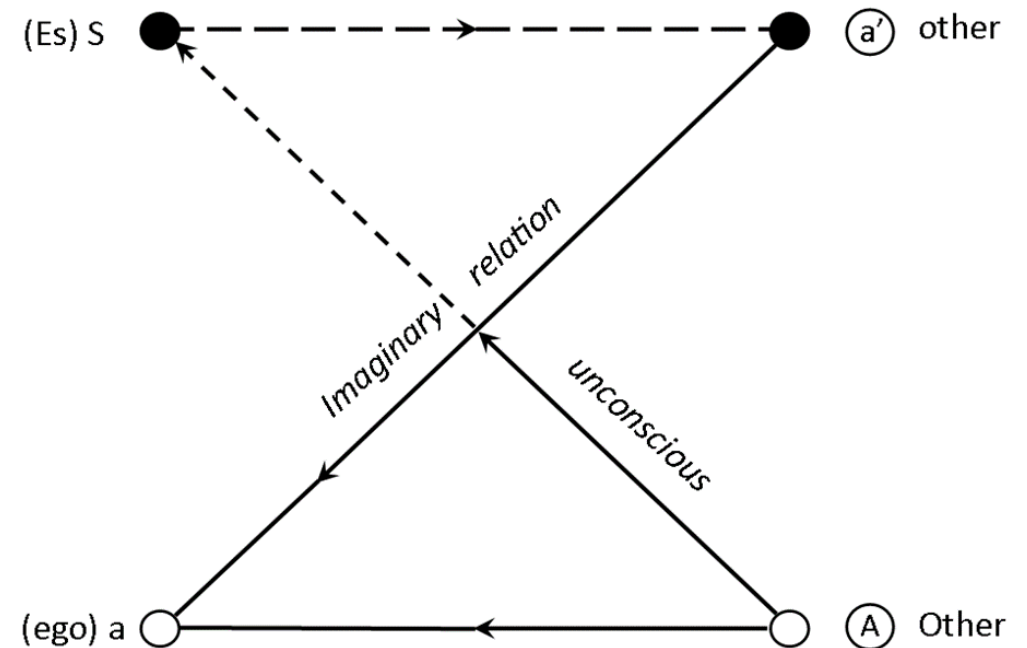
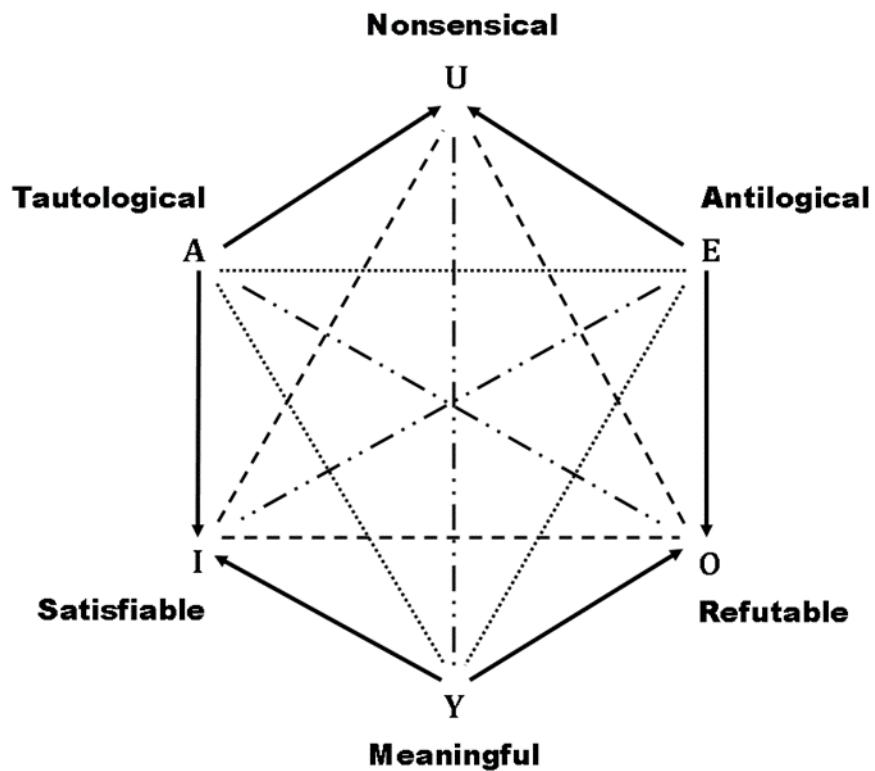
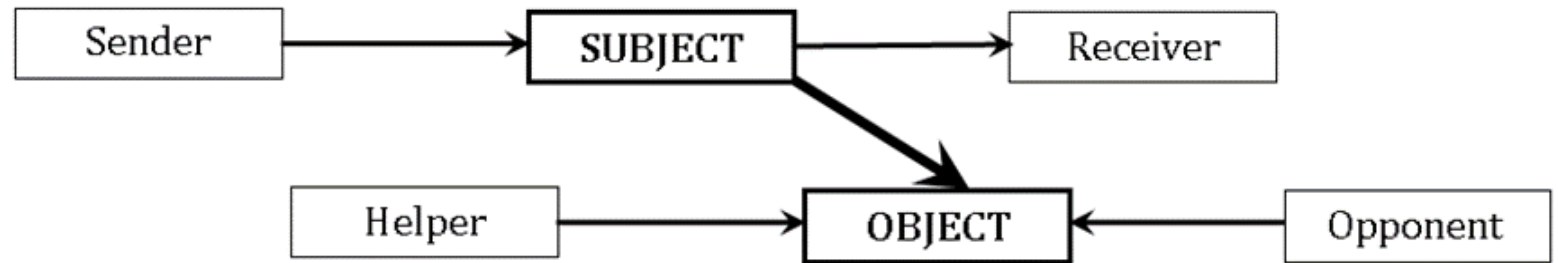
The Topography



Each section of the novel has different Topoi, that correspond to different SF “genres” (According to Malmgren’s classification of SF)

SECTION NAME	SUMMARY	GENRE(S)	TOPOI
Section 1. Residence on Earth	Parody of classical dystopian novels and scientists’ biographies	Alternate Society; Science Fantasy	Planet Earth Bandar-Austro-Metropolis; Widgeree; Yabbie Creek University; Porpoise Point; A farm in the country side near Oregon Accumulators; A hospital; A restaurant; The Parliament House Gardens
Section 2. Galactic Influences	Parody of first contact novels and cli-fi novels	Alternate World; Alternate Society	Planet Earth The Presidential Palace; Room 101 of Victoria Mansion; The Fine Arts Museum; The Cathedral; Brodei; Room 101 of Widgeree's Goodwood Residence; Widgeree's cemetery; Earth Orbit
Section 3. Interplanetary Host	Parody of novels featuring visits to other planets and virtual reality plots	Alien Encounter; Gadget SF	Several Extra-terrestrial planets Titan, A planet orbiting Proxima Centauri; The Galaxy Court in ZxYXly137C; A planet orbiting θ Boötis The Aspergus Asteroid
Section 4. The last galaxy fading away	Surrealist/absurdist “grand finale”	Science Fantasy	A distant point in spacetime from where the last light of surrounding galaxies fade into total darkness; The amphitheatre of Yabbie Creek University

Recurrent Return to Theory



**Each section of the novel has different World Components, Novums and Themes
(According to Malmgren's classification of SF)**

SECTION NAME	SUMMARY	PREDOMINANT WORLD COMPONENT(S)	NOVUM(S)	THEMES
Section 1. Residence on Earth	Parody of classical dystopian novels and scientists' biographies	Natural Law (Science) Natural Law (Natural Actant)	Dystopia Counternatural actant	Self & Society Self & Other
Section 2. Galactic Influences	Parody of first contact novels and cli-fi novels	Topography (planet) Social Order	Catastrophe Dystopia	Self & environment Self & Society
Section 3. Interplanetary Host	Parody of novels featuring visits to other planets and virtual reality plots	Natural Law (Science - Science Fantasy) Topography (object)	Alien / Monster Invention	Epistemology & Ontology Self & Technology
Section 4. The last galaxy fading away	Surrealist/absurdist "grand finale"	Natural Law (Theory)	Time Looping	Epistemology & Ontology

In sum, this is a direct intervention, through a creative work, into “applied literary theory”

Just as when

- Sartre wrote *Nausea* or Camus *The stranger* to explore their philosophy
- Robert Musil wrote *The Man Without Qualities* to document the "story of ideas" of his time
- Robert M. Pirsig wrote *Zen and the Art of Motorcycle Maintenance* to explore his Metaphysics of Quality.
- E.O. Wilson wrote *Anthill* to show that we must save the world from its most savage ecological predator: mankind.

Or more controversially, when

- B. F. Skinner wrote *Walden Two* to promote applied behaviour analysis (the elimination of free will).

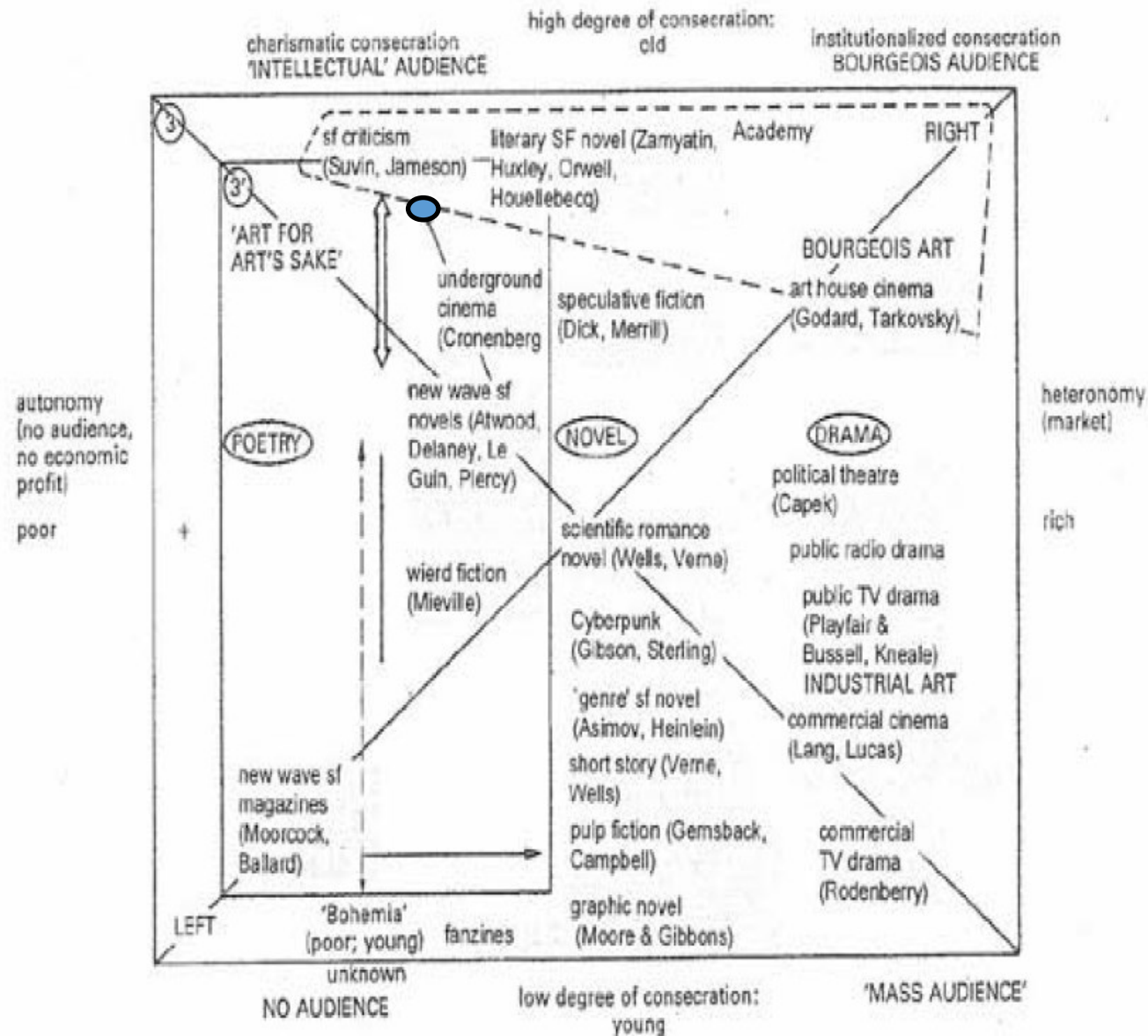
To analyse those novels, exploring the underlying philosophy, intellectual setting, metaphysics, ecology and behaviourism is unavoidable.

In a similar fashion, any literary analysis of *The Unavoidable Resurrection of the Boltzmann Brains* will have to address:

- The challenges to science posed by global warming and increasingly authoritarian interventions (from denialism to social credits) in 21st century society
- The use of equations and other scientific results as “literary devices,” informing the plot and the “natural laws” presented in the novel
- The use of (ancient/outmoded/*your adjective?*) literary theories such as narratology, the actantial model, the structural analysis of fictional universes, etc. (all of which have been untouched by the postmodernist hiatus), as metanarrative devices to structure the novel plot
- The challenges it poses to simplistic and reductionist theories of what science fiction is (or should be), in particular, the view that science fiction models of analysis should neglect story. The novel’s narrative structure and the use of other devices that can be distinctive of the genre show that such a reduction is untenable
- The implicit call to use universal logic approaches as tools of analysis (that can integrate what has been lost when structuralism was discarded and discredited), to create a new consilience, linking again literary theory to “structural” areas of knowledge.

But, of course, these are just hopeful authorial intentions, serious literary analysis will bring out other issues that the author has not thought about

Placement of the novel in other (more recent) critical traditions



The blue dot indicates where the novel may be placed in Milner's (2011) Bordieuan account of the position of SF subgenres within the literary field (again, according to hopeful authorial intentions)

Source: Milner, Andrew (2011) "Science Fiction and the Literary Field." *Science Fiction Studies* , Vol. 38, No. 3 (November 2011), pp. 393-411

The End

Questions?