The Logic of Science

a vivisection of monsters

Jensen, Lars Bang

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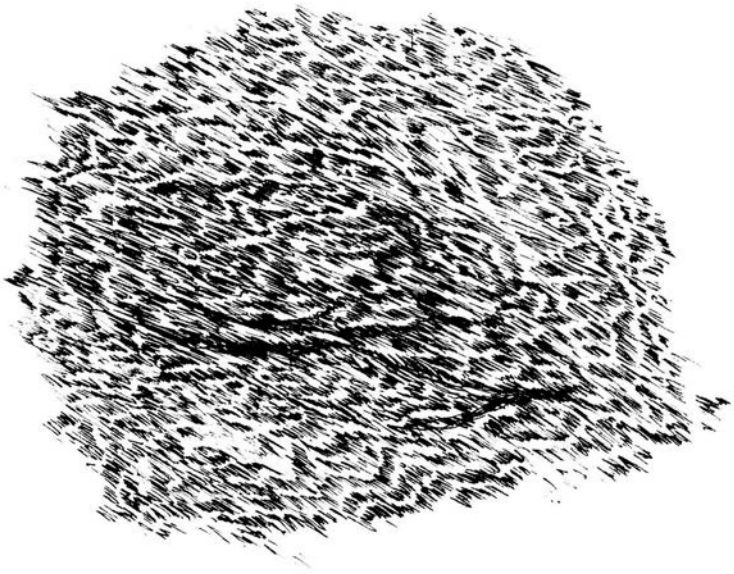

THE LOGIC OF SCIENCE

A VIVISECTION OF MONSTERS

BY
LARS BANG

DISSERTATION SUBMITTED 2014

AALBORG UNIVERSITY
DENMARK

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Thesis submitted:	December 5, 2014
PhD supervisor:	Professor Paola Valero, Aalborg University
PhD committee:	Associate Prof. Elizabeth de Freitas, New Adelphi University, New York
	Professor Gelsa Knijnik, Universidade do Vale dos Sinos, Brazil
	Associate Prof. Ole Ravn (chair), Aalborg University
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Bang, Lars. (2014). Welcome to school - welcome to the Empire-Building Business: an exploration and expansion of Bourdieu's notion of field. Waikota Journal of Education, 19(1), 51-62.

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CV

2002	Bachelor of education (Folkeskolelærer)
2002-2011	Teacher in special education at Skæring Skole, Aarhus, Denmark
2011	Master of education (Pedagogical Psychology), DPU, Copenhagen

ENGLISH SUMMARY

The problematic this thesis investigates, through a specific kind of structuralism derived from a reading of Michel Foucault, Pierre Bourdieu and Gilles Deleuze, concerns how the subject becomes a science subject and potentially a scientist, with interest and literacy in science.

The *Logic of Science – a vivisection of monsters* is thus an exploration of Being and Becoming in relation to Science and its Education. The investigation has been derived from, in, and connected to the Youth-to-Youth Project, a regional bridge building project in Northern Jutland in Denmark.

The Youth-to-Youth Project (2011-2015) attempts to facilitate contact and provide a different kind of counselling and guidance between youths and youths who are 'one step ahead' in their educational trajectory. The meetings between the youths are both social and science subject oriented, and the intention is to establish a longitudinal mentor relationship in upper primary and lower secondary school (specificially 8-9th grade in primary school and 2-3g in the gymnasium) potentially easing the mobility between the respective educational institutions.

The articles and the compiled wrapping is an attempt to reach a new conceptualization, a new Image of Thought in the Deleuzian sense, of Science and its Education and the process of individuation connected to this. The results within the dissertation are thus the very frame, methodology, and reconceptualization of key notions in science education research. The outlined new line of thought is brought to an encounter with the problematic regarding youths and their educational trajectory in Science and its Education. The approaches towards counselling and youth to youth relations in the Youth-to-Youth Project have thus been informed by the investigation and methodology of the dissertation. It has been an attempt to setup an encounter to potentially reach smooth space where the usual restrictions and regulations of education and counselling are temporarily absolved.

The form of the dissertation reflects the content, which turns the very structure and synopsis of the dissertation into a jagged labyrinthine line. The structure thus mimics the theoretical and ontological presuppositions of the dissertation. There is a deliberate attempt to evoke a certain kind of nonsense, a certain kind of confusion, and nonlinearity in the reading of the dissertation.

The content of the dissertation are, beyond the wrapping, five articles and where four is published and one is under review.

The wrapping of the dissertation deploys a Deleuzian philosophy mimicking the problematic of dissertation between striated and smooth space, between Being and Becoming, between sense and nonsense, and the process of individuation. This is done through a labyrinthine structure, which connects art, music and other related surfaces to the above mentioned problematic in education. The wrapping is conjoined thematically to the articles, both leading up to the articles and giving the articles a new perspective.

The article *In the maw of the Ouroboros – an analysis of scientific literacy and democracy* is a specific historical and contemporary investigation of the concept scientific literacy and how is appears and undergoes metamorphoses in three historical instances: Herbert Spencer, Charles Eliot and PISA06. It is thus a specific history of the present of how the concept scientific literacy, as seen in PISA06, came to be. Scientific literacy has an inherent problematic, which especially manifest in its relation to democracy and citizenship. The analysis is here utilizing the toolbox and conceptualizations of Foucault and Deleuze and repositions the concept of scientific literacy within that specific theoretical framework.

The article *Chasing the Chimera's Tails – an analysis of interest in science* is, similar to the above article, a specific historical and contemporary investigation of the concept interest in science (education) in three historical instances: Friedrich Herbart, John Dewey and PISA06. The analysis shows how the concept is influenced by three specific rationalities, which are actualized and manifested differently in the various historical instances. These rationalities influence the way interest in science is thought and practiced in education. In the contemporary manifestion in PISA06 this results in a problematic ultimately limiting the conceptualization of interest and education. The analysis is again utilizing the toolbox and conceptualizations of Foucault and Deleuze and reconceptualizes interest in science within that specific theoretical framework.

The article *Between the Cat and the Principle: an encounter between Bourdieu's and Foucault's conceptualizations of power* constructs a new framework to investigate the problematic of representation of power and forwards a specific methodological position derived from a reading of Foucault and Bourdieu. It is thus an attempt at constructing a methodology, where both theoretical positions and tools are utilized. The rationale for this particular French framework is exemplified through a concrete case from the field of physics: the Solvay Conference of 1927 and how physicist debated the new budding quantum paradigm. This case is outlined and analysed in respect to the problematic of representing power through the joint methodological approach of Bourdieu and Foucault. The analysis forwards a new methodological approach for educational researchers interested in investigating the influence other fields (political, bureaucratic, judicial etc.) exert upon education and specifically how the scientific field influence science education.

The article *Mapping [Capital v.2.0] – an encounter of Thoughts* outlines a new methodological approach to mapping capital and tries to bring Bourdieu's notion of capital to an encounter with Marxist activity theory and Deleuze's line of thought. The article arguments for a necessary expansion of the concept of capital beyond money. This expansion is achieved through a new conceptualization where capital is framed in expressions of human activity and the ontological event. Mapping capital is thus here forwarded as a specific mapping of events, drawing upon the monadology of Gabriel Tarde. Only by acknowledging capital as specific deterritorialized flows and how they are in assemblage with general human activity and ontology can an educational researcher arrive at an adequate notion of mapping capital. The expanded mapping of capital is thus a way of overturning the effects of capitalism in education by showing how capital has become (or is being represented) almost as if it is a part of ontology. The above is outlined through a concrete case: the methodological framework of the investigation of the Youth-to-Youth Project. This particular investigation utilizes a specific structuralism generated through an encounter with Bourdieu, Foucault, and Deleuze based on a Marxist approach to reconceptualise how capital is mapped and thought.

The article *Welcome to school – the empire-building business – an affirmation of Bourdieu's concept of field* arguments for an affirmation and constructive expansion of Bourdieu's concept of field and offers a new Image of Thought (a overturning of the concept in Deleuzian terms) of what a field is and how the agent travels through various fields. It is thus an attempt to fertilize Bourdieu's conceptualization of field with the framework of Foucault and Deleuze. Particularly the notion of the quasi-self-similar fractals is here utilized to arrive at a new Image of Thought of how fields operate and are influenced by the field of power and similar background fields. Finally the subject or agent is here forwarded in extension, utilizing Deleuze's ontology, and is thus seen as if the subject in it self is a travelling fractal. The concrete case used to outline the above is empirical material from the Youth-to-Youth Project. Through an analysis of a range of interviews the argument is that a specific habitus *homo Empiricus* is being fostered, shaped and desired through a specific rationality *The Man of Science*. Bourdieu's notion of habitus is thus here being brought into a fertile encounter with Foucault's notion of discursive formations and rationalities. The claim is that through a new Image of Thought regarding fields educational researchers enhance his or her investigation of fields, the influence between fields, and the subject traversing fields.

This contribution of this dissertation is thus overall the construction of a new analytic, through a reading of Deleuze, Foucault and Bourdieu, which has the aim of overturning the dogmatic view of education and freeing educational thought from inadequate conceptualizations and stale knowledge.

DANSK RESUME

Problematikken som denne afhandling undersøger, igennem en specifik strukturalisme foranlediget af en læsning af Michel Foucault, Pierre Bourdieu og Gilles Deleuze, omhandler hvordan et subjekt bliver et naturvidenskabssubjekt og potentielt en naturvidenskabsmand, der har en interesse og 'læsefærdighed' i naturvidenskab.

Ph.d. afhandlingen *Naturvidenskabens logik – en vivisektion af monstre* er følgelig en udforskning af Væren og Tilblivelse i forbindelse med Naturvidenskaben og dens Undervisning. Undersøgelsen har været udført på, ved siden af og i forbindelse med Projekt Ung-Til-Ung, et brobygningsprojekt i Region Nordjylland Danmark.

Projekt Ung-Til-Ung (2011-2015) forsøger at facilitere kontakt og tilbyde en anden type rådgivning og vejledning imellem unge og unge, der er et 'skridt' længere på deres uddannelsesmæssige løbebane. Møderne imellem de unge er både af social og naturfaglig karakter og intentionen er at skabe et mere tidsligt udstrakt mentorforhold igennem gymnasiet (2-3g) og folkeskolen (8-9 klasse) for potentielt at fremme mobilititen og overgangen imellem de respektive institutioner.

Artiklerne, og den samlede kappe for afhandlingen, er et forsøg på at nå til en ny konceptualisering, et nyt 'Image of Thought' i Deleuze's forståelse, på Naturvidenskaben og dens Uddannelse og individuationsprocessen i forbindelse med denne. Resultaterne i afhandlingen er således selve rammen, metodologien og rekonceptualiseringen af nøglebegreber i naturvidenskabsdidaktik. Den præsenterede nye tankegang bliver bragt til et møde med problematikken om unge og deres uddannelsesmæssige løbebane i forbindelse med Naturvidenskaben og dens Uddannelse. Tilgangene til vejledning, rådgivning og ung-til-ung relationer i forbindelse med Ung-Til-Ung Projektet er således generelt informeret af afhandlingens undersøgelser og metodologi. Det har været et forsøg på at rammesætte et møde for potentielt at nå et 'glat rum', hvor de normale regulativer og restriktioner for vejledning midlertidig er ophævet.

Afhandlingens form afspejler dens indhold, hvilket medfører at afhandlingens struktur og synopsis bliver en labyrintisk takket linje. Strukturen efterligner følgelig de teoretiske og ontologiske forudsætninger for afhandlingen. Der er et bevidst forsøg på at fremmane en specifik slags nonsens, en specifik forvirring i forbindelse med en læsning af afhandlingen.

Indeholdet af afhandlinger er, udover kappen, fem artikler, hvoraf fire er publicerede.

Afhandlingens kappe implementerer Deleuze's filosofi og efterligner problematikken imellem tværstribet (striated) og glat (smooth) rum, imellem Væren og Tilblivelse, imellem fornuft (sense) og nonsens og individuationsprocessen. Dette opnås igennem en labyrintisk struktur, der forbinder kunst, musik og andre relaterede overflader med problematikken omkring udannelse nævnt ovenfor. Kappen er i konjunktion tematisk med artikler, både som optakt til artiklerne og en videre perspektivering udfra artiklerne.

Artiklen *In the maw of the Ouroboros – an analysis of a scientific literacy and democracy* er en specifik historisk og nutidig undersøgelse af begrebet naturvidenskabelig læsefærdighed og hvordan det optræder og undergår forvandlinger i tre historiske forekomster: Herbert Spencer, Charles Eliot og PISA06. Det er en specifik 'nutidens historie' om hvordan begrebet naturvidenskabelig læsefærdighed, som set i PISA06, kom til at være. Naturvidenskabelig læsefærdighed har en iboende problematic, som især manifesterer sig i det relation til demokrati og statsborgerskab. Analysen udnytter her Foucault's og Deleuze's redskaber og begreber og repositionerer begrebet naturvidenskabelig læsefærdighed indenfor denne specifikke teoretiske ramme.

Artiklen *Chasing the Chimera's Tails – an analysis of interest in science* er, ligesom artiklen ovenfor, en specific historisk og nutidig undersøgelse af begrebet interesse for naturvidenskab (naturfag) i tre historiske forekomster: Friedrich Herbart, John Dewey og PISA06. Analysen viser hvordan begrebet er påvirket af tre specifikke rationalitier, der bliver aktualiseret og manifesteret forskelligt i de respektive historiske forekomster. Rationaliteterne påvirker måden hvordan interesse for naturvidenskab bliver tænkt og praktiseret i uddannelse. I den nutidige manifestation I PISA dette resulterer i en problematic, der i sidste instans begrænser konceptualiseringen af interesse og uddannelse. Analysen udnytter igen Foucault's og Deleuze's redskaber og begreber og repositionerer begrebet interesse for naturvidenskab (naturfag) indenfor denne specifikke teoretiske ramme.

Artiklen *Between the Cat and the Principle: an encounter between Bourdieu's and Foucault's conceptualizations of power* konstruerer en ny ramme til at undersøge problematikken omkring repræsentation af magt og fremfører en specifik metodologisk position afledt af en læsning af Foucault og Bourdieu. Det er derfor et forsøg på at konstruere en metodologi, hvor begge teoretiske positioner og redskaber kan blive udnyttet. Rationalet for denne særlige franske ramme bliver eksemplifieret igennem en konkret case fra fysikkens felt : Solvay Konferencen i 1927 og hvordan fysikerne debaterede det nye spirende kvanteparadigme. Casen er skitseret og analyseret i forhold til problematikken om repræsentation af magt igennem en fælles metodologisk tilgang af Bourdieu og Foucault. Analysen fremfører en ny metodologisk tilgang for uddannelsesforskere, der er interesserede i at undersøge påvirkningen andre felter (det politiske, det bureaukratiske, det retslige

osv.) udøver på udannelse og specifikt hvordan det naturvidenskabelige felt påvirker naturfagenes didaktik (science education).

Artiklen *Mapping [Capital v.2.0] – an encounter of Thoughts* skitserer en ny metodologisk tilgang til kortlægning af kapital og forsøger at bringe Bourdieu's kapitalbegreb til et møde med Marxistisk virksomhedsteori og Deleuze's tankegang. Artiklen argumenterer for en nødvendig udvidelse af kapitalbegrebet hinsides penge. Denne udvidelse opnåes igennem en ny konceptualisering, hvor kapital er rammesat i udtryk for menneskelig virksomhed og den ontologiske begivenhed. Kortlægning af kapital er følgelig her fremført som en specifik kortlægning af begivenheder ved at trække på Gabriel Tarde's monadologi. Kun ved at anerkende kapital som specifikke deterritorialiserede strømme og hvordan de er i 'assemblage' med generel menneskelig virksomhed og ontologi kan en uddannelsesforsker nå til et adekvat begreb for kortlægning af kapital. Den udvidede kortlægning af kapital er derfor en måde til at omvælte kapitalismens effekter i uddannelsessystemet (og uddannelsesforskning) ved at vise hvordan kapital er blevet (eller repræsenteres) næsten som om det er ontologisk bestanddel. Det ovenstående skitseres igennem en aktual case: den metodologiske ramme af undersøgelsen af Ung-til-Ung Projektet. Denne særlige undersøgelse udnytter en specifik strukturalisme genereret igennem et teoretisk møde med Bourdieu, Foucault og Deleuze baseret på en marxistisk tilgang til at rekonceptualisere hvordan kapital kortlægges og tænkes.

Artiklen *Welcome to school – the empire-building business – an affirmation of Bourdieu's concept of field* argumenterer for en bekræftelse, i Deleuze's forstand, og en konstruktiv udvidelse af Bourdieu's feltbegreb og tilbyder et nyt 'Image of Thought (tankebillede i Deleuze's forstand, der skal omvælte/omvende begrebet) på, hvad et felt er og hvordan en agent bevæger sig igennem felter. Det er følgelig et forsøg på at 'befrugte' Bourdieu's feltbegreb med Foucault og Deleuze's ramme. Særligt udnyttes begrebet *quasi-self-similar-fractals* for at afstedkomme et nyt tankebillede (Image of Thought) på, hvordan felter operer og er påvirket af magtens felt og lignende baggrundsfelter. Endelig bliver subjektet eller agenten her fremført i 'dets udbredelse' (extension) ved at trække på Deleuze's ontology, og er derfor set som om subjektet i sig selv er en fraktal i bevægelse. Uddrag af det empiriske materiale fra Ung-til-Ung Projektet bliver anvendt som case for at skitsere og illustrere ovenstående. Igennem analysen af en række interviews er argumentet og påstanden, at et specifikt habitus *Homo Empiricus* bliver fremmet, formet og ses som ønskværdigt igennem en specifik rationalitet *The Man of Science*. Bourdieu's habitusbegreb bliver derfor her bragt til et frugtbart møde med Foucault's begreb omkring diskursive formationer og rationaliteter. Påstanden er, at uddannelsesforskere, igennem et nyt tankebillede (Image of Thought) af felter, styrker deres undersøgelser af felter, påvirkningen felter imellem og subjektets bevægelse igennem felterne.

Bidraget for denne afhandling er derfor samlet set konstruktionen af en ny analytik, igennem en læsning af Deleuze, Foucault og Bourdieu, der har til mål at omvende det dogmatiske billede af uddannelse og frisætte uddannelsesmæssig tænkning fra inadekvate begreber og flad viden.

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Cast in order of appearance

Executive Producer:	Paola Valero (supervisor)
Producers:	Susanne M. Nielsen (Aalborghus Gymnasium)
	Ole Rokkjær (Projektleder Ung-Til-Ung)
Instructors:	Mr. Bang
	Mr. Bang Jensen
Interior art and design	Anders Bang Jensen
	Christian Bang Jensen
	Melissa Andrade
First chorus	The SMERG research group
Second chorus	The CfU research group
Third chorus	The participants in the Youth-to-Youth Project

Starring in The Logic of Science

The Structural Hero	Mr. Bang ∫ Mr. Bang Jensen
The Structural Villain	Mr. Bang Jensen ∫ Dr. Bang
The Flash	Michel Foucault
Aquaman	Gilles Deleuze
Green Lantern	Pierre Bourdieu
EMINEM	The Flash
Rammstein	Aquaman

Bob Dylan	Green Lantern
Leonard Cohen	Himself
Tom Waits	Everyone else

.

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[X] IN MEDIAS RES – PRESUPPOSTITIONS OF THE INVESTIGATION

Parable of the lighted lamp
"No one, when he has lit a lamp, covers it with a vessel or puts it under a bed, but sets it on a lampstand, that those who enter may see the light.
"For nothing is secret that will not be revealed, nor anything hidden
that will not be known and
come to light.
"Therefore take heed how you hear. For whoever has, to him more will be given; and whoever does not have, even what he seems to have will be taken from him."
(Scofield, 2006, p. 1413 , Luke 8: 16-18)

There is a crack in everything. That's how the light gets in.

(Cohen, 1992, Anthem)

1...2...3...4...5...6...7...8...9 und aus
Alle warten auf das Licht
fürchtet euch, fürchtet euch nicht
die Sonne scheint mir aus den Augen
sie wird heut nacht nicht untergehen
... und die Welt zählt laut bis zehn

(Rammstein, 2001, Sonne)

This is a superficial PhD thesis. This is a study of the Surfaces of Science[i] through the bodies of a structuralist, a Structural Hero ∫ Villain. It is a study of the structural surfaces of Science, surfaces of Thought,[ii] surfaces of discourse, surfaces of Bodies[iii], surfaces of sense and non-sense. One of these surfaces is its Education.[iv]

To explore a surface is to explore its ontological *Extension*[v], its spatio-temporality, to walk along the paths offered by it, to topologically map its various eddies, whirls, dead ends, sink holes, hidden passages and obscure caverns. An exploration of surfaces is an exploration undertaken in great *Speed*[vi], because all too often the surface disappears after one has trod upon it; it alters and throws up a new form for the next voyeur of the surface. The form of the exploration of a surface is a *Labyrinth*[vii], its intricate dimensions are unknown to the voyeur of the surface even though the explorer knows he is walking upon a sacred path and along a route not

arbitrary but constructed. The labyrinth is thus both in ontological *Thought* and in *Extension*, it is the labyrinthine form sensed by the voyeur and the structural landscape, which is uncovered.

Given this form an exploration of the surfaces of Science can thus never be linear or completely sensical. This means that when exploring the surfaces of Science one often encounters all that Science has/must cast out: the irrationalities, non-Science, non-sense and the subjective aesthetic gaze.

Everything on a surface unfolds in series of singular events, unfolding in a nonlinear jagged line. Two structural *Series*[viii] unfold upon this surface of Science and its Education: 1) A series of the Science-Image connected to the language and signs of Science, and their signification, denotation and manifestation 2) A series of the Science-Structure (lat. *fabric*) connected to structures and bodies of Science.

The *Movement*[ix] in the exploration thus becomes a double movement in both directions at once: 1) a movement of measured rationality, good sense, Reason and all its connected forms of knowledge 2) a movement of nonsense, of irrationality, invoked by all those corners and shadows, which resist the gaze of science such as science-fiction, comics, aesthetics and art. This double movement between and amongst the series of Science aims to grasp, or capture, the displacement between sense and nonsense, and how the paradoxical object = x displaces the structural series of Science.

But following the series in a double movement isn't enough, one needs to implement a cut, a *Vivisection*[x], uncovering and connecting in novel ways live tissue so that one can gaze at and reassemble the structures of Science. A vivisection of the dogmatic Image of Thought[xi] in Science and its education is needed to arrive at a new fresh Image of Thought to show how the series of Science are relationally connected and displaced. This fresh Image of Thought is necessary precisely to expand the understanding of Becoming in Science and how the dogmatic Image of Thought rests upon an inadequate Cartesian understanding of the Cogito, which is unable to capture the individuation in relation to Science and nature.

This thesis is thus constructed as a labyrinth and the starting point is buired within the labyrinth. There is no clear beginning; the entry point is arbitrary since in many ways the research undertaken in this thesis was started before the PhD research began. The structure of the thesis thus tries to mimic and reproduce the research activities, thoughts and processes undertaken from 2011-2014 in connection with the Youth-to-Youth Project by invoking the image of the labyrinth. This means that alongside the articles, research papers and published book chapters, there will be a labyrinth unfolding, being trod, which reflects commentaries, non-sense, reflections and empirical material connected to the various 'proper' articles.

The reader of this thesis is thus invited inside this immanent labyrinth, not just within the thoughts and mind of the PhD researcher, but within the surface of Science and its Education. To wander and read such a labyrinth is, in a classical understanding, to open oneself to new connections, walk along the sacred paths, uncover hidden corners, unfound truths and enlightenment. It is to face the irrational monster, to shake ones head in disbelief, to laugh out loud and condemn the new constructions and nonsense within with a critical gaze of Science itself.

The thesis can be read from the beginning to end but that will be a plain and linear/dogmatic reading. The reader will thus potentially be unable to capture the fresh Image of Thought regarding the Logic of Science and Becoming and the necessary jagged line explored in the thesis. To follow the labyrinth is to follow two movements, one of sense and one of nonsense, and one should stay oriented towards the chain of Fibonacci sequence unfolding on the pages to know one's direction and guide the reader to related surfaces of Thought.

You walk the labyrinth in your own peril for within the labyrinth you are not alone, another passenger is hunting you, tracking your movements. So, read and walk the labyrinth in due haste and do not look over your shoulder or gaze too long at the shadows within. Luckily Structural Heroes will help you make sense of your voyage and will give you a sense of direction and smell.

Welcome inside the labyrinth, I hope you enjoy your path.

[X,Y] A STRUCTURAL GUIDE FOR THE LABYRINTH

> One after another, I should like to explore the many paths that lead to the heart of these challenging tests. As Deleuze has said to me, however, this metaphor is misleading: there is no heart, but only a problem - that is, a distribution of notable points; there is no center but always decenterings, series, from one to another, with the limp of a presence and an absence - of an excess, of a deficiency. *Abandon the circle, a faulty principle of return; abandon our tendency to organize everything into a sphere. All things return on the straight and narrow, by way of a straight and labyrinthine line*.
>
> (Foucault, 1977, pp. 165-166, my emphasis)

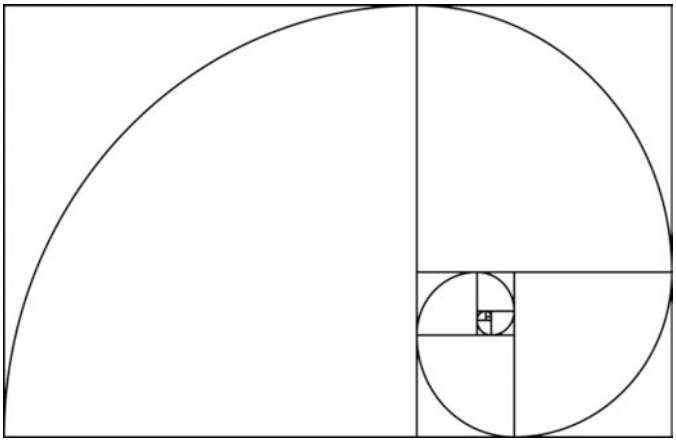
> "To boldly go where no man has gone before"
>
> (Daniels, 1966, Star Trek: Original Series)

> He was the only man of us who still "followed the sea." The worst that could be said of him was that he did not represent his class. (…) The yarns of seamen have a direct simplicity, the whole meaning of which lies within the shell of a cracked nut. But Marlow was not typical (if his propensity to spin yarns be expected), and to him *the meaning of an episode was not inside like a kernel but outside, enveloping the tale which brought it out only as a glow brings out a haze, in the likeness of one of these misty halos that sometimes are made visible by the spectral illumination of moonshine*.
>
> (Conrad, 1990, p. 105, Heart of Darkness, my emphasis)

In each passage, chamber, cavern, crevice or 'section of PhD thesis' two movements unfold in two series of Thought, *images* and *connections*, and every page contains these two series. A movement of sense, Reason, Understanding and self-account held together with their smooth connected forms; and a movement of non-sense, irrationality and connected assemblages. These two movements follow the two series in various ways. The series are 1) a series of the Science-Image and 2) a series of Science-Structure. Some times the series converge and the image resembles the structure, other times they diverge, conjugate and everything becomes mixed. The labyrinth, and this PhD thesis, is constructed to be read as a plunge, a fall and an immersion into a labyrinth that already is. Therefore the start is in the middle and one can follow the Structural Hero in various directions in the labyrinth or follow the labyrinths and how it reflects upon the Structural Hero. There is though a guide of natural reason, a Fibonacci-chain of numbers, an expression of nature unfolding, which can help one orient oneself in which part of

the labyrinth one is now treading. This clear map of Reason, and structural layering act as Theseus' classical ball of thread in the labyrinth. The map of Reason is intended to provide a fabric, which potentially help the reader to navigate and chart the reading within.

[Y,φ] A MAP OF REASON - THE GOLDEN SPIRAL



Fibonacci Sequence used: ⎨0, 1, 1, 2, 3, 5, 8, 13, 21, 34…⎬

’Sections’ explained:

Every section in the thesis is a spiral, a Fibonacci sequence in itself, erupting from and towards the respective articles and chapters. The structure of the quasi-self similar fractal, shown in the article *Welcome to school*, is thus used as an Image of Thought to capture this fractal movement in a smooth space of Thought. A movement which erupts and bursts forth, through and towards the articles and various other writings.

Surfaces of Thought – The mapping of the labyrinth:

Every spiral is connected through all the other spirals and to guide the explorer of the labyrinth through the rhizomatic connections the nomenclature of the square is used. There are squared markers in the text connecting concepts and sections (mimicking surfaces of Thought). For example [3,5]´ is a reference to a connection to that particular surface and fold. The voyeur of the labyrinth is encouraged to follow these ’markers’ in the labyrinth, dizzying though it might be… Additionally the section headings are connected again using the Fibonacci markers, if a section states [2,3]´ – [1,1]´´ – [13,21]´ – [0,1] it means the section of [2,3]´ is connected to those respective surfaces.

[φ, 𝓕] THEMES AND LAYERS IN THE SECTIONS

0 – **Enter the Void (The Empty square between 1 and 1)**

- The individual in individuation
- Becoming in intensity

1 – **@n Ouroboros in the middle of things** [article – *In the Maw of the Ouroboros*]

- Tracing the YtY-Project
- Scientific Literacy, the surface of Knowledge
- Knowing, Knowledge and Learning

1 – **The Cavern of the Chimera** [article – *Chasing the Chimera's Tails*]

- The secret door in the Chimera
- Historical addendum – to be inserted between x and y of the chapter

2 – **The Celestial realm of the Structural Hero** [article –*Between the Cat and the Principle*]

- The specific structuralism of the investigation and how it relates to Science and its education
- Two machines and a wormhole
- The Wardrobe of the Pallid Masks/Fight Club in Education
- Sowing a new Image in the Fields of Power
- Historical addendum to be added between page x and y of the article

3 - **The Earthly carnivale of the Structural Villain** [article – *Mapping [Capital v.2.0]*]

- Problematics of the thesis
- Smooth/Striated Space and the relation to Science and its education
- Relations to other theories and new materialism
- The sleep of Reason produces monsters (painting)

5 – **The Living Archive – before the tableaux of Science and its Education** [article – *Welcome to School*]

- Archives of the surface
- How comics, music and science fiction is connected to the problematic of Becoming in Science
- The Comic[s] Machine
- A triptych of Dark Science
- Before the parachute opens (painting)
- Here there be dragons –Qualitative and Quantitative investigation of structure
- Lecture on The Logic of Science ∫ Science of Logic

(∞ - 1) – **A minor Koda**

[ℊ, Z] A READERS GUIDE TO THE LOGIC OF SCIENCE – A VIVISECTION OF MONSTERS

A Warning Sign! – or Do not enter the Labyrinth before reading this carefully

The content of the thesis is the form of the thesis. The form of the thesis is the content of the thesis. *The Logic of Science – a vivisection of monsters* is assembled to mimic a specific experience, adopting a specific strategy. The labyrinth, in which the reader is immersed, is meant to potentially invoke a dizzying experience, inducing nonsense employing the strategy of making the reader constantly grasping for a straw of sense. There is thus a purposeful disorientation, to prove a point regarding the overall problematic of the thesis – Becoming and Being in science. *There is no linear line of argumentation to be traced, only an experience of a jagged thematic line of connected surfaces.* A labyrinth is never understood while one is walking or reading forward, understanding is reached backwards when trailing back from the heart of the labyrinth, having glimpsed the essence of it all, toward the entry/ exit. The Labyrinth, in a way, mimicks lived life, the plane of Immanence, or as Kierkegaard said:

> It is quite true what philosophy says; that life must be understood backwards. But then one forgets the other principle: that it must be lived forwards. Which principle, the more one thinks it through, ends exactly with the thought that temporal life can never properly be understood precisely because I can at no instant find complete rest in which to adopt a position: backwards. (Kierkegaard, 1996)

The structure within the Labyrinth thus mimicks this particular nonlinear unfolding, showing how specific surfaces of Thought, related to science, connect to the articles and other writings ahead and behind. This particular nonlinear unfolding is related to Spinoza's concept of knowledge, and the 'insight' the labyrinth aims to provide for the reader/walker. Spinoza says the 3rd kind of knowledge is only reached when one see everything connected through God and to attain that connection one has first to go to the particular, then to the universal and finally back again to the particular fueled by joyful passions (Deleuze, 1990; Spinoza, 1996). Every quotation and reference is thus carefully placed, situated within the structure, connecting particular surfaces potentially invoking particular themes - this is similar to the surreal / nonsensical cinematography of Buñuel (Buñuel, 1929) . In the connections between the various surfaces something new arises and is birthed – a new monster sees the light of day. Sometimes these quotations and references seemingly make no sense, again that is on purpose, only by relating the seemingly unrelated is it possible to arrive at some sensical position from which to reconsider Science and its Education. The reader is encouraged to follow the quotations atleast on the surface: listening to the music quoted, browsing the movies referenced and so forth - everything is then potentially revealed regarding the relation between The

Logic of Science and the problematic of Becoming to the careful explorer of the labyrinth.

[Z,N] LANGUAGE OF THE LABYRINTH – METATRON'S VOICE

The wrapping of this thesis draws upon the concepts and a reading of Gilles Deleuze. In particular Deleuze's reading of Spinoza in *Expressionism in Philosophy : Spinoza* (Deleuze, 1990) and *Spinoza: Practical philosophy* (Deleuze, 1988) and the work *The Logic of Sense* (Deleuze, 2004b), have greatly influenced the vivisection and gaze upon the notions, nomenclature and structure within the labyrinth of Science and its Education. This means that notions such as Speed, Extension, Thought, Surface and many others are seen within Deleuze's line of thought and his particular Spinozist structuralism.

The language used to construct the labyrinth in the following pages can seem esoteric, mystical and nonsensical. Indeed it is intended to mimic a non-scientific language and account. As mentioned above it is additionally a consequence of mimicking Deleuze/Spinoza/Nietzsche/person=x's thought. So without an attempt to initiate a series of language related to theirs that effort would be naught. Upon the first initiation and use of a conceptual term there will be a reference to the actual works and a list of endnotes explaining the usage and reference. The nonsensical references will not have references as that is against their nature. The traveller of the labyrinth is encouraged to delve into those as much or as little as he/she dares; they are in their own the true pathway to the exploration this thesis has attempted.

[N,N+1] THE LABYRINTH AND SCIENCE EDUCATION - ON STRIATED AND SMOOTH SPACE[xii]

> Thus are constructed and crisscrossed the mechanical figures of *the two great mythic spaces so often explored by Western imagination: space that is rigid and forbidden, surrounding the quest, the return, and the treasure (that's the geography of the Argonauts and of the labyrinth); and the other space-communicating, polymorphous, continuous, and irreversible-of the metamorphosis, that is to say, of the visible transformation of instantly crossed distances, of strange affinities, of symbolic replacements (the place of the human beast).* But it must be remembered that it's the Minotaur who watches within Daedalus' palace, and after the long corridors, he is the last challenge; on the return journey, the palace which imprisons him, protects him, was built for him, manifests externally his mixed monstrous nature. (Foucault, 1986, p. 80, my emphasis)

Foucault sensed the labyrinth, and the specific spaces within, early in his reading of Raymond Roussel and the book devoted to him bore its name *Death and the Labyrinth: The world of Raymond Roussel* (Foucault, 1986). Foucault thus connects metamorphosis with the labyrinth and the two mythic spaces of Becoming:

But what have these two forms of spaces, which will be explored in the labyrinth below, to do with Science and its Education? Education is an attempt to facilitate a becoming, a metamorphosis, a structural attempt manifested in a plethora of institutions and aimed at transformation of subjects. *Education is an ordered striated space of progress*[xiii]*, from which the 'two great mythic spaces' Foucault mentions have been exorcised from - cast out due to their monstrous and mythic nature*.

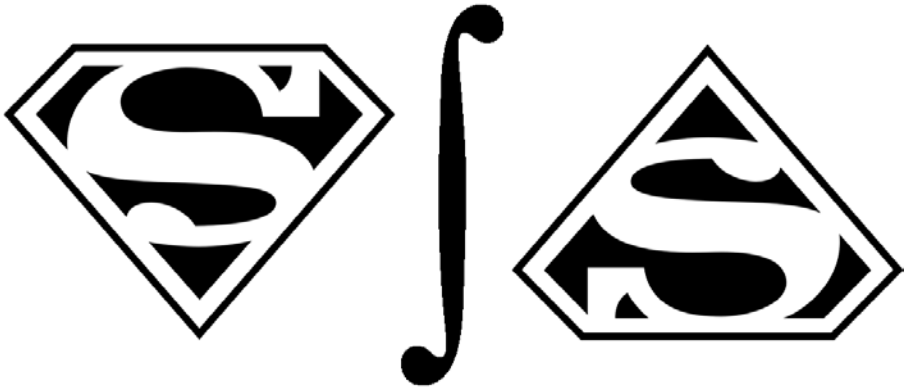
This thesis is thus a rallying cry clamoring on different strata and one of them is connected to this necessary dark, mythic side of education / Science, which transforms Spinoza's statement "We don't know what a body can do" (Spinoza, 1996) to "We don't know what education can do". Education has never been adequate and reached a point of sufficient reason[xiv] - education has never been intense enough. Education thus needs to be connected and explored in relation with ontology as well as with the conditions of possibility offered in the various institutions. Ontology becomes ethics in the Spinozist stance.

> The labyrinth is linked to the metamorphosis, but according to an equivocal plan: it leads, like Daedalus' palace, to the Minotaur, the monstrous fruition which is marvel and also a trap. But the Minotaur, by his very being, opens a second labyrinth: the entrapment of man, beast, and the gods, a knot of appetites and mute thoughts. The winding of corridors is repeated, unless it is perhaps the same one; and the mixed being refers to the inextricable geometry which leads to him. *The labyrinth is at the same time the truth and the nature of the Minotaur, that which encloses him externally and explains him from within. The labyrinth, while hiding, reveals; it burrows into these joined beings it hides, and it leads to the splendor of their origins.* (Foucault, 1986, p. 87, my emphasis)

The mythic spaces of the labyrinth must be sought out, explored and mapped because it is the very entrapment of man, which is at stake. The entrapment of thought in structural systems of rigidity, producing and reproducing a specific subjectivity based upon a sterile dogmatic Image of Thought actualized within Science and its Education. It is almost as if we are implored to enter the labyrinth anew, and to escape the entrapment of man we have to reconnect with the mythic spaces of Becoming, which are hidden inside the labyrinth.

> Parable.—Those thinkers in whom all stars move in cyclic orbits are not the deepest: he who looks into himself as into a vast space and bears galaxies within also knows how irregular galaxies are; they lead into the chaos and labyrinth of existence." (Nietzsche, 2001, p. 180)

***The Joker**: And here... we... go!(Nolan, 2008)*



A book of philosophy should be in part a very particular species of detective novel, in part a kind of science fiction.(…) This is the secret of empiricism. Empiricism is by no means a reaction against concepts, nor a simple appeal to lived experience. On the contrary, it undertakes the most insane creation of concepts ever seen or heard. (Deleuze, 1994, p. xix)

[1]´ @N OUROBOROS IN THE MIDDLE OF THINGS

> The alchemists were fond of picturing their *opus* as a circulatory process, as a circular distillation or as the uroboros, the snake biting its own tail, and they made innumerable pictures of this process. Just as the central idea of the *lapis Philosophorum* plainly signifies the self, *so the opus with its countless symbols illustrates the process of individuation, the step-by-step development of the self from an unconscious state to a conscious one*.
>
> (Jung, 1968, p. 418, my emphasis)

[1,1]´ THE RIGHT PASSAGE OF DESCENT – [987,1597]´´´

> Reise, Reise Seemann Reise
> Jeder tut's auf seine Weise
> Der eine stößt den Speer zum Mann
> Der andere zum Fische dann
> Reise, Reise Seemann Reise
> Und die Wellen weinen leise
> In ihrem Blute steckt ein Speer
> Bluten leise in das Meer
> (Rammstein, 2006, Reise, Reise)

[1,2]´ THE FIRST MOMENT OF NON-SENSE

Unknown as to why and how he ended up there, the first passage the Structural Hero stumbles upon is in the middle of things, near sator arepo ∫opera rotas, and the mover of the labyrinth. He finds himself in a narrow, earth like space, crawling on his stomach like a worm. It smells of upturned earth and decomposition. The passage is heaving and contracting as if it itself is a great beast following the steady pulse of its breath. Crawling forward he realizes he is subtlety descending.

In a grille in the earthy floor, a wormhole, he glimpses down upon a circular chamber containing great machinery, which implores him to explore its cogs and wheels to examine how this labyrinth was reconstructed, vivisected. In the cavernous ceiling directly above the grille is a celestial window to a place of wondrous alchemy and endless transformations. Ahead is only darkness and an even steeper descent. Looking back to whence he came, the hero realizes he is connected by an umbilical cord connecting him to the light of the surface above.

Crawling further down suddenly the path begins turning in a helical movement. A realization dawns, the Structuralist Hero is crawling towards the maw of the Ouroboros.

[2,3]´ THE RIGHT CAVERN WALL OF SENSE

On the right cavern wall hangs a large map of connections of seemingly endless scope, an assemblage[xv], the centre is marked with the name The-Youth-to-Youth-Project (YtY Project), Northern Jutland, Denmark. The name is posited within the outside of the triptych of dark Science The Chimera/The Ouroboros/The Gorgons [233,377]´ – [377,610]´. Endless red lines, stippled dots extend in all four directions, all four dimensions. Tracing the thickest of the red lines it ends in the name *Scientific Literacy // Interest in science*, a seemingly twin like serial structure, and from that unfolds again an endless series of connections. The Ouroboros, Scientific literacy and the Youth-to-Youth project are seemingly connected. The second name one encounters from tracing the YtY Project—– Scientific literacy is PISA06 and its double Nationale Mål (National Aims). It seems as if there is a chain of manifestation: YtY is a manifestation and actualization of Scientific Literacy/Interest in Science, which again is connected with PISA06/Nationale mål and all constructed within and upon the Ouroboros. The Structuralist Hero, compelled by an unconscious structural necessity, unfolds/flicks open his razor and begins vivisecting the surface, exposing the Walking Dead of Science.

[3,5]´ THE LEFT ACCOUNT OF REASON - A TRACING OF THE YOUTH-TO-YOUTH PROJECT

The Youth-to-Youth-Project was funded with a specific intention:

> "the purpose is to give rural youths, who have potential with regards to the science subjects, an opportunity to get a thorough knowledge of the subject areas of science and the social study environment, which characterize the next step in their possible educational trajectory."1

This intention of bridge building between primary and secondary/upper secondary schooling in Science is not unique - a series of lines are traced to similar projects both in Denmark and internationally (Dohn & Højgaard, 2014; Osborne & Dillon, 2008; Sjøberg & Schreiner, 2010) It is as if there is a specific intention, a specific spirit, to push, cajole, lure and facilitate students towards a career and educational trajectory related to Science. The Youth-to-Youth-Project is seen by the Structural Hero as a specific manifestation and actualization, in an assemblage, of that overall intention and desire to educate more students within the Science subject areas. The

[1] http://ntsnet.dk/projektboersen/projekter/ung-til-ung. My translation from Danish.

concepts in science education research of Scientific Literacy and Interest in Science are thus enveloped within the framework of the YtY-Project. The discursive formations of Scientific Literacy and Interest in Science are connected on the surface to this manifestation in Northern Jutland. The Structural Hero had plummeted head first into this manifestation and the connected problematic.

One of the first problems encountered in the project was again linked to the purpose of the project:

> "To identify and support youths in the rural areas of the region, who have the potential for further studies and creating a career within the scientific and technical areas, but for whom for different reasons being personal, social and geographical such a path is not necessarily is a natural choice" (s.5, my translation)

The problematic connected to the identification of those youths the project specifically wanted to target and help; it was as if they were already out there in virtual form but just hadn't manifested yet. Statistics from the educational demographic of the region supported such a virtual youth and showed that too few science students were hatched in the last few years according the aim of the government (Lange, Johannesen, & Henriksen, 2010).

This resulted in a split in the Structural Hero, a fundamental division, between the researcher and the evaluator/developer [2] – [3]

[5,8]´ SCIENTIFIC LITERACY, THE SURFACE OF KNOWLEDGE AND THE OUROBOROS IN THE YTY PROJECT

Something moves Science and its Education from within the Void [0]. This something is not merely the cold calculations, the rigorous experiments and the strict methods. There is a something, an object=x, which moves and displaces the structural series of Science. It is not one thing, but several Abstract Machines, several Diagrams connected in ad finitum. This something is overlooked, looked down upon and exorcised from proper scientific Reason. In no area is this problematic more obvious than in Education. There is a fantasy of a cold, reductive movement of Thought within Science that only exists in literature and in the virtual/actual – represented by Occam's Razor as the stereotypical / dogmatic Image of (Scientific) Thought.

The Ouroboros is the Abstract Machine[xvi] enveloped within Scientific Literacy (ref), which dynamically shifts between its various aspects of turning outward and inward constantly renewing and destroying stale and insufficient knowledge/Reason/Understanding through the workings of the rationalities connected to this machine.

In the YtY-Project, the two actualized series regarding the Science-Image and Science-Structure are in divergent. The series of the Science-Image is specifically manifested as the 'problem' regarding choice of the rural youths and their related Becomings and Being. Somehow the series of the Science-Image does not seem appealing, too un-sexy and non-compossible[xvii] for the youths in the specific areas of the region. Similarly the series of Science-Structure, consisting of the language which propels science outwards and the bodies of the youths in these specific contexts, are equally 'out of sync' with the series of Science-Structure and their connection to the dominant discourse regarding Being-Scientific. Science is proposed to be for all but just not for me (the rural youth)[2].

The Ouroboros is thus enveloped in a specific form and aspect within the YtY Project, and we see here that the aspect of the Aristocratic, Ascetic and Noble Scientific Literacy is being one of the series noncompossible to the youths. Several strata thus appear to be in assemblage with the problematic related to the YtY Project and a vivisection of Scientific Literacy thus provides a lens to gaze upon the connected problematic and how it becomes related to specific desired forms of structure, Becoming and Being connected to late capitalism[xviii]. A new map is needed, a new connection where Scientific Literacy becomes the pivot, which cracks open the surface revealing the rhizomatic connections.

Scientific Literacy is a concept connected to the Scientific Knowledge. There is thus an intrinsic connection between the discourse formation of Scientific Literacy and the overall Episteme of Science itself and related discursive formations regarding what scientific knowledge is and should be (Foucault, 1972). In other words Scientific Literacy is connected on the surface, through structural series, to Scientific knowledge, to an idea of Knowing[xix]. An analysis of Scientific Literacy can thus never be solely an analysis of conceptual development, frequency in research literature, a comparative study, or other seemingly pure textual analyses – as is frequently the case in research literature. Rather, an analysis of Scientific Literacy needs to be connected to an investigation of ontology. A question arises: How is Knowing connected to Being and Becoming? In other words, what presumably happens to a subject once it knows something? And in relation to this question another question arises: What has knowledge to do with Becoming and Being?

[2] http://www.project2061.org/publications/sfaa/

http://www.britishscienceassociation.org/science-society/science-all

http://www.phmetropol.dk/Forskning/Skole+og+padagogik/Science+didaktik/Naturfag+for+Alle

These questions are directly or indirectly explored in the article *In the Maw of the Ouroboros* but outlined below is a further exploration, enunciating the connection to Deleuze.

[8,13]´ KNOWING, KNOWLEDGE AND LEARNING

> Every body, every thing, thinks and is a thought to the extent that, reduced to its intensive reasons, it expresses an Idea the actualization of which it determines. However, the thinker himself makes his individual differences from all manner of things: it is in this sense that he is laden with stones and diamonds, plants "and even animals".
>
> (Deleuze, 1994, p. 316)

The above quote makes shows how Deleuze's notion of Thought is closely related to Spinoza's attribute of Thought (Deleuze, 1988, 1990; Spinoza, 1996). Thought is thus in the same movement vastly expanded to all things and simultaneously 'reduced' to intensities. One can never return to a Cartesian understanding of The Cogito or the typical Kantian I (which continuously haunts Education), while retaining Deleuze's notion of intensities [1,1]´´. This means that in the above problematic of the YtY - Project there is a Becoming-Ouroboros, an intensive individuation, connected to Science and Scientific Literacy. One should not search for the intensive individuation in the heights of Scientific Reason and Understanding, in the curriculums of the striated ordered institutions, but in the murky intensive depths of Becomings. Such a process can of course never be willingly directed, Learning is not Becoming, Knowing is not Being.

Scientific Literacy is a *living concept* connected to 1) Knowledge, Knowing and Learning -the 'literacy' part of the concept 2) and to Science - the 'scientific' part of the concept.

Knowing is seen by Deleuze (or Sean Bowden's reading of him) as an

> "ongoing, open-ended and differential process involving the simultaneously actualization of ideal, pre-individual relations in persons, individual things, and the concepts corresponding to these persons and individuals." (Bowden, 2011, p. 131)

But how can one initiate a movement to reconnect Scientific Literacy, this flawed concept and inadequate idea, to the monstrous intensive Becoming-Ouroboros? How can one vivisect the concept, assemble it anew in a fresh Image of Thought, not as a representation but as a simulacrum?[xx] This monumental task is the task of all educators, of all discipliners as a utopian simulacrum for the future, an eternal return signaling a new kind of apprentice and a new kind of teacher.

To set the Structural Hero on the path of the new apprentice and the new teacher it is crucial to make a sharp distinction between Learning and Knowledge.

> The exploration of Ideas and the elevation of each faculty to its transcendent exercise amounts to the same thing. These are two aspects of an essential apprenticeship or process of *learning*. For, on the one hand, an apprentice is someone who constitutes and occupies practical or speculative problems as such. Learning is the appropriate name for the subjective acts carried out when one is confronted with the objecticity of a problem (Idea), whereas knowledge designates only the generality of concepts or the calm possession of a rule enabling solutions(…)To learn is to enter into the universal of the relations which constitute the Idea, and into their corresponding singularities. (Deleuze, 1994, pp. 204-205)

One aspect of the apprenticeship is the confrontation with the Idea and belongs to the unconscious.

> As a result "learning" always takes place in and through the unconscious, thereby establishing the bond of a profound complicity between nature and mind. (Deleuze, 1994, p. 205)

In the other aspect of the apprenticeship there is invoked a horror of the faculties, often seen actualized in a structural attempt in Education to ignore the dissolved Self and the fractured I [0] – [1,1]´´. An illusion surrounding Education and a particular training of the faculties, training the Eye to see objectively, training the Reason to deduce and so forth. Kant showed this conflict clearly in his critiques...

Deleuze writes of the fallacy of the 'education of the senses' as:

> The apprentice, on the other hand, raises each faculty to the level of its transcendent exercise. With regard to sensibility, he attempts to give birth to that second power, which grasps that which can only be sensed. This is the education of the senses. From one faculty to another is communicated a violence which nevertheless always understand the Other through the perfection of each(…)We never know in advance how someone will learn: by means of what loves someone becomes good at Latin, what encounters make them a philosopher, or in what dictionaries they learn to think. The limits of the faculties are encased one in the other in the broken shape of that which bears and transmits difference. (Deleuze, 1994, p. 205)

Deleuze's notion of learning and the fallacy of education becomes clearer by exposing the connection between the 'individual in intensity' and the 'fractured I'. In the above the 'limits of the faculties' are this broken line and the limits of sense.

> There is no more a method of learning than there is a method of finding treasures, but a violent training, a culture or paideïa which affects the entire individual (…)(Deleuze, 1994, p. 205)

There arises thus a need for overturning innately flawed concepts in educational research (Scientific Literacy, Interest in Science and so forth) and reassembling them in a new way.

> Learning takes place not in the relation between a representation and an action (reproduction of the Same) but in the relation between a sign and a response (encounter with the Other) (…) That is why it is so difficult to say how someone learns: there is an innate or acquired practical familiarity with signs, *which means there is something amorous - but also something fatal - about all education*. We learn nothing from those who say: "Do as I do". Our only teachers are those who tell us to "do with me", and are able to emit signs to be developed in heterogeneity rather than propose gestures for us to reproduce. In other words there are no ideo-motivity, only sensory-motivity. (Deleuze, 1994, pp. 25-26, my emphasis)

Can science education and the learning 'therein' reach such an understanding? What does the future of science truly hold?

> *Future of science*. - Science bestows upon him who labours and experiments in it much satisfaction, upon him who learns its results very little. As all the important truths of science must gradually become common and everyday, however, even this little satisfaction will cease: just as we have long since ceased to take pleasure in learning the admirable twotimes-table. But if science provides us with less and less pleasure, and deprives us of more and more pleasure through casting suspicion on the consolations of metaphysics, religion and art, then that mightiest source of joy to which mankind owes almost all its humanity will become impoverished. *For this reason a higher culture must give to man a double-brain, as it were two brain-ventricles, one for the perceptions of science, the other for those of non-science: lying beside one another, not confused together, separable, capable of being shut off; this is a demand of health.*(Nietzsche, 1996, p. 119, my emphasis)

[13,21]´ ARTICLE – IN THE MAW OF THE OUROBOROS

In the maw of the Ouroboros – an analysis of scientific literacy and democracy

L. Bang (lbj@learning.aau.dk)
Institute of learning and philosophy, Aalborg University, Nyhavnsgade 14, 9000 Aalborg, Denmark.

Abstract

This paper explores the concept of scientific literacy through its relation to democracy and citizenship. Scientific literacy reached its pinnacle of attention in the 21st century with the Programme for International Student Assessment survey of 2006. It is no longer just a concept but has become a stated and testable fact in the research community of science education. This paper problematizes the marriage between scientific literacy and democracy, particularly the idea that scientific literacy is a presupposed necessity to achieve proper citizenship and awareness of the role of science in modern society. Research has presented a historiography of the evolution of scientific literacy. Through the use of Foucauldian genealogical and archaeological analytical strategies and Gilles Deleuze's line of thought, it is argued that scientific literacy is not a recent invention and one that is problematic in its relation to democracy. The concept of scientific literacy has undergone specific transformations in the last two centuries and has been enacted in different manifestations throughout modernity. The obvious link between science and democracy is an effect of specific rationalities within the epistemological field of science (episteme), rather than intrinsic, essential characteristics of science or scientific literacy. There is nothing intrinsic either in its function for democracy. Through a case study of the work of Charles W. Eliot and Herbert Spencer and the modern enactment of scientific literacy in contemporary science education, this paper shows the cultural and historical contingencies on which the relation between scientific literacy and democracy have been constructed through a rationality this article calls the Man of Science. The mythical Ouroboros will be used as a fresh Image of Thought to explore the movements and folds within the discursive formation of Scientific Literacy, the rationality of the Man of Science, and their relation to democracy.

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Keywords: scientific literacy · democracy · Deleuze · Foucault

The greatest striving of the mind, and its greatest virtue is understanding things by the third knowledge.
(Spinoza, 1996)

A knowledge most base

Scientific knowledge, understood as the knowledge of the pure natural sciences, has passed a certain threshold in contemporary society. It is no longer bound and inhibited by other knowledge domains but flows freely through all forms of knowledge, reaching a point where knowledge is science. Religion, faith, human codes of conduct, democracy – everything can be explained scientifically and measured, inferred, and rationalized. No knowledge domain has resisted the deterritorialized flows of science.[1] Since the early 1950s, in the Sputnik era, scientific knowledge has been categorized and measured as a concept called scientific literacy (Hurd, 1958). This continuous extension of scientific knowledge creates a problematic in the educational field, which is actualized in the relation between notions of citizenship, democracy, and scientific literacy.

Scientific literacy[2] is the desired aim of science education qua the acquisition of scientific knowledge. By having an interest in science, the student is led to a point, a brink, of having achieved a modicum of literacy in science. Scientific literacy thus become a chief component in the ideal blueprint of Being-Scientific/Homo empiricus, which revolves around a desired Being-Scientist (Bang, 2014; Bang and Valero, 2014). In other words, the State introduces and enacts – in science educational curricula, practices, and so forth – a specific blueprint and template for the desired scientific student/subject, which should lead to a specific

[1] Deterritorialization is a concept that was used by Deleuze and Guattari (1983, p.33). It refers to the way scientific knowledge extends itself to everything and recodes it all through the axiomatic flows of science.

[2] I use the capitalized terms *Scientific Literacy, Democracy,* and *Citizenship* when they refer specifically to the discursive formation as a whole, which is seen here as both encapsulating and enveloping both science literacy and scientific literacy (Roberts, 2007).

type of desirable scientist. This scientific literacy is measured, weighed, and compared in international tests; specifically, the design of the Programme for International Student Assessment (PISA) test and survey of 2006 (PISA06) contained the element and desired measurement of scientific literacy (Bybee, McCrae, and Laurie, 2009). The notion of scientific literacy as a specific kind of literacy is embedded in the practices of science education and now ipso facto rests on this necessary premise of a particular form of literacy in science. This particular literacy has been lauded in contemporary research and in international tests as a chief factor in attaining citizenship, global and environmental awareness, and other related notions (Aikenhead, 2002; Hurd, 1998, 2002; Kolstø, 2001; Miller, 1998; Roth and Barton, 2004).

Paul DeHart Hurd (1998, p. 409) described how the rise of scientific literacy was extended to include everyone, in comparison to earlier traditional views of the scientific disciplines:

> In 1970, the National Science Foundation (NSF) Advisory Committee for Science Education recommended that the traditional approach to science education in the sciences be rethought with more "emphasis on the understanding of science and technology by those who are not and do not expect to be professional scientists and technologists" (Report, 1970, p. iii). The implication is that notions of scientific literacy should be embedded in contexts that promote a *socially responsible and competent citizen*. The traditional concept of a discipline (biology, chemistry, physics, earth science) as entities no longer have much meaning beyond that of cataloging university and school science courses [my emphasis].

Scientific literacy has thus become a contemporary component in the overall skill and knowledge set of a democratic and 'socially responsible and competent citizen'. Similarly, the American Association for the Advancement of Science's Project 2061 stated their overall intention as 'a long-term research and development initiative focused on improving science education so that all Americans can become literate in science, mathematics and technology'.[3] In other words, since the 1950s, scientific literacy has almost become synonymous with science education and contemporary research in scientific literacy has addressed the particular

[3] See http://www.aaas.org/program/project2061.

issues of the 'growing polarization between advocacy positions' in scientific literacy and how hard it is to define, pin down, and put into practice (Roberts, 2007, p. 729). In that line of research, George E. DeBoer (1991, 2000) pointed out that scientific literacy had a long and convoluted history *before* the 1950s, when it was entwined with general educational history. DeBoer (2000, p. 583) noted a specific origin of thought regarding science education with reference to Charles Eliot and Herbert Spencer and other authors of the mid-19th century:

> Notable among those who publicly spoke in favor of science teaching were Thomas Huxley, Herbert Spencer, Charles Lyell, Michael Faraday, John Tyndall, and Charles Eliot (DeBoer, 1991). Their job was not an easy one. The humanities were firmly entrenched as the subjects that were thought to lead to the most noble and worthy educational outcomes. Scientists had to be careful when arguing the utility of science not to present science as too crassly materialistic and without higher virtue. So in addition to discussing the practical importance of science in a world that was becoming dominated by science and technology, they also said that science provided intellectual training at the highest level—not the deductive logic that characterized most of formal education, but the inductive process of observing the natural world and drawing conclusions from it.

This 'polarization' of scientific literacy will be examined in three historical transformations, or instances, also mentioned by DeBoer: 1) that of Herbert Spencer, 2) that of Charles Eliot, and 3) finally, that of the contemporary form in PISA06.

To summarize, this article notes four elements related to the problematic of scientific literacy: 1) the extension/expansion of scientific knowledge; 2) a specific ideal template for students in education/science; 3) new forms of measurement and categorization, exemplified in PISA06; and 4) scientific literacy's relation to democracy.

This article examines the particular relations between scientific literacy, democracy, and citizenship through a contemporary, historical investigation casting new light on the above 'troublesome nature' through the methodological 'toolbox' of Michel Foucault (1972) and Deleuze. The following further delineates the different parts of the problematic, associating it with the theoretical perspective of the article that enunciates the problematic of Becoming and Being in science education.

A reconceptualization of Scientific Literacy and its relation to Being and Becoming

Scientific Literacy, like its twin concept/discursive formation Interest in Science, is associated with a particular expression of desired Being and the notion of modern enlightenment (Bang and Valero, 2014; Popkewitz, 2008). The aim is to transform the student, through science education, to enlighten the student towards the idealized version of Being-Scientific[4]/Homo empiricus, however fragmented that particular utopian mould might be. Scientific literacy is the seed Education/the State wishes to sow to produce scientists through enacting an alchemy so the best students become enlightened in the ways of science (Popkewitz, 2004). Producing a specific form of universal Being, legislated towards a desired subjectivity, creates a specific kind of disciplination,[5] requiring a specific kind of disciplinarian attempting to enforce the unforeseeable and restrict thought. One of these contemporary disciplinarians is PISA's modern test regime.

Deleuze, later with Guattari, revealed this particular failing in Western thinking, a dogmatic Image of Thought and the inherently flawed thought in terms of Being and identity (Deleuze, 1994; Deleuze and Guattari, 1983, 1987). The 'individual in intensity' (Deleuze, 1994) is 'produced' in terms of Becoming,[6] not moulded toward a specific Being. Scientific knowledge, knowledge regarding nature, has a fundamental role in that continuous process. The concept of scientific literacy is an inadequate idea without connection to this process of Becoming. A reconceptualization is thus necessary to drag the concept of scientific literacy from its Platonic heights to Earth and expose the necessary monster and abstract machine within.[7] The concrete case of Scientific Literacy's relation with Democracy[8] through a notion of Citizenship[9] serves as a vehicle, a concrete case, to expose the intrinsic problematic of Scientific Literacy and to reconceptualize/reaffirm the concept as a whole in a new Image of Thought (Deleuze, 1994).

[4] Being-Scientific is related to Being-Scientist, which is seen as an effect of Being-Scientific (Bang and Valero, 2014). The specific Habitus, in the Bourdieuian sense, of Homo empiricus is examined by Lars Bang (2014).

[5] A specific form of subjectivation through an educational disciplining of Mind and Morals.

[6] The term *Becoming* here is in the Deleuzian sense.

[7] The Ouroboros is another term for the specific Abstract Machine or Diagram of Scientific Literacy.

[8] As Scientific Literacy, this refers to the discursive formation of Democracy.

[9] Since the above Citizenship is seen here as a particular rationality within several discursive formations, especially the discursive formation of Democracy.

The image of the Ouroboros

To reach a new Image of Thought of scientific literacy, this article draws upon the image of the Ouroboros to obtain a common notion[10] of the monstrous dual nature of the rationalities within Scientific Literacy, which is exemplified and enunciated in the section 'A vivisection of the discursive formation of Scientific Literacy – exposing the Ouroboros'.

The Ouroboros is a mythological creature connected to notions of greed, appetite, self-destruction, and endlessness and Carl Jung (1968) associated it with his notion of alchemy and related it to the transformation and genesis of the self. Norse mythology called it the Midgard Serpent, the worm/serpent encircling the whole world, destined to slay Thor in Ragnarök. The Ouroboros has surfaced in many places, with different meanings and connotations, but always associated with change and alchemy (Garrett, 1926; Lindsay, 1970; Mahdihassan, 1961; Sheppard, 1962). The use of a fresh Image of Thought associated with the ancient one is inspired by Friedrich Nietzsche's use of such images as Ariadne and Dionysus and is not to indicate a new symbolism, but a necessary eternal return and, in particular, to release it from a Cartesian understanding of knowledge and Cogito (Deleuze, 2006b; Nietzsche, 2005).

The Ouroboros is articulated and brought forth from the discursive formation of Scientific Literacy and specifically from PISA06, Charles Eliot, and Herbert Spencer. First, however, it is necessary to outline the vivisection[11] of the historiography of Scientific Literacy and the 'history of the present' (Foucault, 1995, p. 31), the specific methodology employed, before the Ouroboros can be connected to the problematic under investigation and the specific instances of Spencer, Eliot, and PISA06.

[10] The term *common notion* is used here to emphasize that the article overall draws upon Spinoza's differentiation and process regarding knowledge and the idea to which scientific literacy relates.

[11] I use the term *vivisection/to vivisect* to refer to the specific Foucauldian and Deleuzian gaze and reconceptualization of dogmatic images of thought and concepts. This is very much an active movement of thought – hence the term *vivisection* – and it entails cutting up live formations of discourse, opening up thinkers, and so forth. In other words, it is a cut on the surface of thought (see also Bang and Valero, 2014).

Figure 1. The Ouroboros by Anders Bang

A vivisection of the discursive formation of Scientific Literacy – exposing the Ouroboros

Scientific literacy is a concept evolving around at least two specific aspects: 1) a specific desired scientific Mind/Cogito linked to Being-Scientific (Bang, 2014; Bang and Valero, 2014), which is contemporarily explained as scientific competencies, skills, awareness, and so forth (Hurd, 1998, 2002), and 2) a modicum of scientific knowledge, both of science itself and science's role outside of itself (society, the State, social perspectives, etc.) (Laugksch, 2000). In other words, scientific literacy is closely connected to the corpus of knowledge of science; it is almost a derivative or distillation of what is most worthwhile in science, paraphrasing Spencer (1888). This body of knowledge of science is not a stable body or formation and the conceptualizations and lines of thought by Foucault and Deleuze are invoked to vivisect it.

The knowledge of science has expanded in modernity to represent what Foucault (1972) called an episteme or epistemological field. When Science became an episteme in itself, science became the very horizon of thought, replacing religion as Western civilization's primary worldview. Foucault and others have enunciated this new, vastly expanded role of science (Bachelard, 1984; Daston and Galison, 2007; Daston and Lunbeck, 2011; Daston and Park, 1998; Foucault, 1970, 1972; Whitehead, 2011).

The episteme of science gives birth or begets various discursive formations, like icebergs calving off a glacier. These discursive formations float freely on the plane of immanence, their

life in the actual educational practices in the institutions, science curricula, and other 'things' in the non-discursive field. A discursive formation and its dispersion on the plane of immanence were described by Foucault (1972, pp. 41–42) as follows:

> Whenever one can describe, between a number of statements, such a system of dispersion, whenever, between objects, types of statement, concepts, or thematic choices, one can define a regularity (an order, correlations, positions and functionings, transformations), we will say, for the sake of convenience, that we are dealing with a *discursive formation* – thus avoiding words that are already overladen with conditions and consequences, and in any case inadequate to the task of designating such a dispersion, such as 'science', 'ideology', 'theory', or 'domain of objectivity'.

These discursive formations are governed and changed by the current epoch and, in a sense, represent the epoch through what Foucault (1972, p. 42) called *rules of formation*:

> The conditions to which the elements of this division (objects, mode of statement, concepts, thematic choices) are subjected we shall call the *rules of formation*. The rules of formation are conditions of existence (but also of coexistence, maintenance, modification, and disappearance) in a given discursive division [my emphasis].

The discursive formations related to science and Being-Scientific/Homo empiricus take many guises: Interest in Science, Scientific Literacy, Scientific inclusion, Scientific objectivity, and so forth; they all share similarities relating to their origin (though arbitrary) of the episteme of thought (science). The discursive formations are structural elements governed by the episteme's rules of formation actualized in the practices, statements, concepts and discourses, and other bodies where they are used and operationalized (Deleuze, 1986, 2004; Foucault, 1972). When discursive formations are enacted and actualized in various historical singularities in the non-discursive field, they *differentiate*; this is similar to Deleuze's (1986, 1994, 2004) notion of the virtual and its actualization. This means that discursive formations are continually undergoing metamorphoses, becoming influenced and entangled with other discursive formations, other series of structures, again begetting strange new hybrids or conceptual monsters, often unrecognizable from earlier manifestations of the discursive formation. Foucault (1972) clearly stated that the origin of a discourse and its discursive

formation is arbitrary. One can never know where a concept originated and it does not matter for this paper's analysis, which is a different kind of historiography than proposed by contemporary research in scientific literacy (DeBoer, 2000; Laugksch, 2000; Shamos, 1995).

Discursive formations share threads, or undercurrents, of *rationalities*. These rationalities also act as the very framework, membranes, and corners of the discursive formations and bodies that link up, in compossible or noncompossible[12] ways (Deleuze, 1990), to other discursive formations of the episteme itself.

Deleuze (1986) used three concepts regarding Foucault's specific methodology and two in particular are utilized in this vivisection: the notions of the Archive, the Map, and the Diagram. The Archive is the particular actualized discursive formation examined in the writing of PISA06, Spencer, and Eliot – that is, texts and statements. The Map is connected to their spread, an assemblage, on the horizon – science education practices, curricula, and other instances– an aspect only briefly touched upon here. Finally, the Diagram, or the abstract machine of the Ouroboros, represents a particular relation of forces that constitutes Power and these manifest in a given epoch and subsequently change and shift in time. As Deleuze (1986, p. 34) stated,

> What can we call such a new informal dimension? On one occasion Foucault gives it its most precise name: it is a 'diagram', that is to say a 'functioning, abstracted from any obstacle … or friction [and which] must be detached from any specific use'. The diagram is no longer an auditory or visual archive but a map, a cartography that is coextensive with the whole social field. *It is an abstract machine. It is defined by its informal functions and matter and in terms of form makes no distinction between content and expression, a discursive formation and a non-discursive formation.* It is a machine that is almost blind and mute, even though it makes others see and speak [my emphasis].

The Diagram(s) are a multiplicity of heterogeneous relations in the social field(s). There is thus a diagram of science education and, more specifically, of scientific literacy, of forces and Power, that serves as the condition of thought and un-thought in science education. Diagrams

[12] The concepts of compossibility and non- or incompossibility are derived from Deleuze's (2006a) reading of Gottfriend Wilhelm Leibniz and entails, here, the ways in which series of structures or discursive formations exclude each other, making them 'different worlds' in their own sense.

influence diagrams, meaning that the diagram of late capitalism (or similar epochal diagrams) and its specific flows of deterritorialization influence and connect with the diagram of scientific literacy:

> The diagram or abstract machine is the map of relations between forces, a map of destiny, or intensity, which proceeds by primary non-localizable relations and at every moment passes through every point, 'or rather in every relation from one point to another'. (Deleuze, 1986, p. 36)

These specific rationalities, composing and connected in the diagram of scientific literacy, from the episteme of science, *almost* exorcise the irrationalities of un-thought (the monstrous becomings) and reduce them to infinitesimal instances, their dark twins or monsters, so to speak (the becoming-Ouroboros).

What is particular about the discursive formation of Scientific Literacy is a *twin set of rationalities, which both structure and manifest upon the surface of the discursive formation*. These rationalities connect to the image of the Ouroboros and are conceptualized as 1) the Helix, referring to the cyclical and spiral progress of science and the eternal return of the Möbius strip, and 2) Momentum, referring to the expansion, movement, unrest, and desire/appetite of science. There is a reason the depicted image of the Ouroboros (Figure 1) is coiled like a Möbius strip: a dynamic is enveloped within these two rationalities, an empty square where the object = x resides, the paradoxical element that drives the abstract machine itself (Deleuze, 2004).

These rationalities are gathered in the image of the Ouroboros to emphasize two things: 1) the intrinsic connection between specific Becomings and science (Deleuze and Guattari, 1987) and 2) that these are a part of a pre-symbolical, almost mythological totemic becoming or dark side of Science and the construct and Image of Thought of the Ouroboros help capture this aspect of scientific literacy. In other words, the rationalities of Momentum and the Helix envelop a particular abstract machine within science that creates a dynamic movement called *ouroborossification*, which, as a whole, threads together the discursive template of the Man of Science – consisting of the rationalities of the Helix and Momentum (and potentially related to other rationalities). Between the two rationalities of the machine is a differentiation between the Helix and Momentum, similar to Deleuze's use of *dx/dy* (Deleuze,1994) ; there is a 'finite' infinity of multiplicities of actualized manifestations between these two rationalities on the

plane of immanence. These rationalities are revealed in the respective analyses below (i.e. Spencer, Eliot, and PISA06) in their various manifestations.

The problematic of contemporary scientific literacy is especially connected to the workings of this abstract machine: Scientific Literacy has become too bloated, no longer destroying itself adequately, and is nearing a critical resting point. The Ouroboros thus functions as a 'fresh' Image of Thought (Deleuze, 1994), revealing the intrinsic conflict within Scientific Literacy, opposing the dogmatic Image previously associated with scientific knowledge and Scientific Literacy.

In addition to discursive formations and rationalities, there is a third crucial element to the toolbox: the notion of *conceptual personae* (Deleuze and Guattari, 1994). The conceptual personae in this case are Spencer and Eliot and the architects of PISA06. Their thoughts are, of course, in a sense, their own, but they are similarly seen as an envelope of the historical diagram and thus inserted in an episteme. Deleuze's reading of Foucault helps capture the conceptual personae in different grids or fields. To capture the gist of Spencer and Eliot, it is therefore helpful to position them along different horizons, with a vertical axis for the Archive and a horizontal axis for the Map and the Diagram of forces and Power external to their thoughts.

To summarize, scientific literacy is an inadequate idea (Deleuze, 1988, 1990; Spinoza, 1996), an inherently flawed concept that does not fully grasp the abstract machine coiled within. In other words, scientific literacy is *a conceptual monstrum* (Bang and Valero, 2014) enveloped within a discourse formation. The vivisection and specific gaze applied here will overturn the concept, affirm it, and assemble it anew and show how it is connected to Becoming and the abstract machine of the Ouroboros. The conceptual monstrum is traced in Spencer, Eliot, and PISA06 and placed within the grid of its birth and transformations, that is, the Archive, the Map, and the Diagram. First, however, the gaze turns to an Archive of the present before carefully vivisecting the transformations of the Ouroboros and scientific literacy and locating shifts and turns.

The Ouroboros in the archive of PISA06

The PISA06 is a manifestation and actualization of Scientific Literacy in an international survey and it is thus toward this fresh Archive that one turns to glimpse the Ouroboros in its discursive formation and its link to Democracy. The authors associated with the Organisation

for Economic Co-operation and Development (OECD) and the designers of the framework clearly defined scientific literacy as follows:

- *Scientific knowledge and use* of that knowledge to identify questions, acquire new knowledge, explain scientific phenomena and draw evidence-based conclusions about science-related issues
- *Understanding* of the characteristic features of science as a form of human knowledge and enquiry
- *Awareness* of how science and technology shape our material, intellectual, and cultural environments
- *Willingness* to engage in science-related issues and with the ideas of science, as a reflective citizen (OECD, 2007, p. 23)

On the surface of the discursive formation of Scientific Literacy, Scientific literacy is thus connected to a specific set of competencies (using scientific knowledge, understanding, awareness, willingness) belonging to the 'reflective citizen'. This set of competencies is part of the idealized, almost Platonic mould of Being-Scientific. The OECD (2007) emphasized that the new concept of literacy has been expanded in the last two manifestations PISA2000 and PISA2003. In the new definition, the linkage between technology and science has been emphasized, as well as the role of science and society. In the OECD's clarification of the above definition, they explained the bullet point about willingness and the reflective citizen as follows:

> The second part of the statement covers various aspects of attitudes and values that individuals may have towards science. The phrase implies a person who has an interest in scientific topics, thinks about science-related issues, has a concern for issues of technology, resources and the environment, and reflects on the importance of science in personal and social perspectives. (OECD, 2007, p. 23)

The last statement reveals the discursive template of the reflective citizen, which is a citizen possessing scientific literacy. This citizen is, in a similar line of thought, dubbed 'citizen science', connecting science to practically every human endeavour and practice (Roth and Barton, 2004, p. 159): 'It makes sense to conceive of scientific literacy in terms of "citizen

science," which is "a form of science that relates in reflexive ways to the concerns, interests and activities of citizens as they go about their everyday business."'

The template and rationality of the reflective citizen/citizen science that is called the Man of Science here, in all its historical manifestations and transformations, is presupposed to be connected to Democracy. This presupposition first showed its contemporary manifestation in the 1950s (Hurd, 1958; Purpus, 1954) but is similarly seen in countless historical manifestations and transformations dating back to Spencer's writings and beyond. In other words, there is a long, jagged historical linking between knowledge and democracy, of which Eliot/Spencer and Scientific Literacy become a transformation, differentiation, and actualization.

The Ouroboros outlined in PISA06 until now is thus observable in at least one of its major rationalities, Momentum, since Scientific Literacy is continuing to increase its scope, body of knowledge, and the meaning of scientific literacy, as in the last two manifestations PISA2000 and PISA2003. Also visible here is how the notion and thus the discursive formation of Democracy becomes connected to scientific literacy. This relation takes place through the persona and discursive template of the reflective citizen, the Man of Science; in fact, they embody the unspoken presupposition between each other – the reflective citizen is needed for democracy and vice versa. There thus seems to be an implicit structural series of supposed causality and rationality in both directions:

Science education⇔scientific literacy ⇔ reflective citizen ⇔ democracy.

Seen from the other end of the series of linkages, science education and all that it entails could not exist without democracy. In other words, science and democracy fit together remarkably like hand and glove, in an intrinsic and perhaps problematic marriage. So far, in PISA06, there are no traces of the rationality of the Helix; it is as if the spiral movement was straightened out in favour of Momentum. One thus turn to vivisect the contemporary concept and discursive formation of Scientific Literacy, outside of PISA, in educational research, and see how the inner workings of the concept are assembled before including the contemporary concept in a scheme relating it to the rationalities of the Ouroboros.

The state of the present – a conflicted dichotomy in the concept and its discursive formation

In a contemporary conceptual analysis of the concept of scientific literacy Roberts (2007, p. 729) emphasized two intrinsic but different visions connected to scientific literacy:

> I shall argue that all of this diverse literature can be better understood if one comes to grips with a continuing political and intellectual tension that has always been inherent in science education itself. I refer to the role of two legitimate but potentially conflicting curriculum sources: science subject matter itself and situations in which science can legitimately be seen to play a role in other human affairs.

These two threads are the two magnetic poles in the discursive formation of Scientific Literacy, which, again, in the terms proposed here, is connected to the Diagram of the Ouroboros and the rationalities encircling it. Roberts (2007, p. 730) argued that they have become increasingly in conflict with each other:

> That is, there seem to be two visions of [Scientific Literacy] that recently have come to represent the extremes on a continuum. I shall call them, simply, Vision I and Vision II, where a vision is much broader analytical category than, say, a definition.

These visions, or threads, in the discursive formation of Scientific Literacy are, of course, often entwined but, nevertheless, represent two completely different idealizations of scientific literacy:

> Vision I gives meaning to [Scientific Literacy] by looking inward at the canon of orthodox natural science, that is, the products and processes of science itself. At the extreme, this approach envisions literacy (or, perhaps, thorough knowledgeability) *within science*…. Against that, Vision II derives its meaning from the character of situations with a scientific component, situations that students are likely to encounter as citizens. At the extreme, this vision can be called *literacy* (again read thorough knowledgeability) *about science-related situations* in which considerations other than science have an important place at the table. (Roberts, 2007, p. 730 , my emphasis)

Roberts' extensive contemporary analysis pointed out the contemporary effect and the state of the conflicted concept of scientific literacy. The two intrinsic visions, which Roberts constructed, however, cloak the problematic nature and thus the cause of such an inner relation. In short, they obfuscate the abstract machine of the Ouroboros, which is the cause, and show only its skewed effect. The historical analysis outlined here shows how these visions, in their historical transformations and arbitrary origin, are ultimately opposed and noncompossible. In other words, contemporary problems regarding scientific literacy can be traced through different transformations in the historical discursive formation, which gave arbitrary birth to the concept in the first place. *The heuristic device of the two visions constructed by Roberts to explain the dichotomy and differences between scientific literacy and science literacy is thus not an arbitrary structure or simple device of rhetoric/argumentation, but a transformation of a historical unresolved dichotomy – an obfuscation of the Ouroboros.*

Together with the Image of Thought of the Ouroboros and its intrinsic rationalities, this article traces the transformations of Roberts' binary of Vision, *which is ultimately considered connected to the two rationalities of the Ouroboros*, with Vision I connected to the ascendancy of the Helix inward looking/eating and Vision II connected to the ascendancy of Momentum gobbling up the world and enveloping it within Scientific Literacy. It is almost as if the Ouroboros has been sick since birth, from being either gluttonous and too fat or ascetic and too thin.

Poles of Scientific Literacy	Major aspect of the Abstract Machine	Minor aspect of the Abstract Machine	The actualized Rationality
Vision I (Noble Science) Charles W. Eliot	The Helix	Momentum	The Man of Science (Aristocratic Asceticism)
Vision II (Scientism) Herbert Spencer	Momentum	The Helix	The Man of Science (Religious Asceticism)

Table 1. Configurations of the discursive formation of Scientific Literacy and the enveloped Ouroboros.

The particular skewed configuration between the two visions and the Ouroboros within is the result of this inadequate idea of scientific literacy. In Spinoza's language, a common notion of the concept of scientific literacy has not yet been reached (Deleuze, 1990; Spinoza, 1996). There is, of course, an interchange, a function between the two visions, but it is one where the Real is never adequate, never common enough. Vision I turns inwards toward science, restricting both the Momentum meaning that the Ouroboros becomes too narrow, too thin, ascetic and restricted. In Vision II, Scientific Literacy is turned outward/outside, in the extreme case straightening the Ouroboros, making it too hungry, incorporating too much knowledge, meaning that scientific literacy becomes too bloated and nearing a resting point. In other words, the schism between the two poles of Scientific Literacy is actualized in a manifested differentiation in the rationality of Man of Science. Two templates of desired utopian and Platonic templates of Being-Scientific are thus manifest and actualized: 1) an ascetic aristocratic Noble Science and 2) an ascetic Religious Scientism. These templates leave only infinitesimal space for minor Science or an assemblage to dark Science and monstrous becomings.

Eliot and Spencer acted as concrete cases or actualizations of these two different visions in their various discursive manifestations. The exact contemporary connection, or hybridization, of these two visions, their actualized templates, and the specific threading of the rationalities in the contemporary concept are the exposed problematic regarding the troublesome nature of scientific literacy. After this enunciation of the contemporary Ouroboros

and problematic Visions I and II, the next section returns to the alleged father of scientific literacy, Herbert Spencer (1820–1903), and demonstrates the postulates of Table 1.

What knowledge is of most worth?

There is a relationship between the thoughts of Charles W. Eliot (1834–1926) and Spencer, which was the main reason why Roberts' (2007) historiography of scientific literacy mentioned them together. Eliot's introduction to the compilation of Spencer's (1888) essays acknowledged Spencer's great influence and impact on his contemporary effort to develop science education at Harvard. Spencer, overall, had a huge influence on contemporary thought. His contribution to bridging Darwin's thought to sociology and politics had especially widespread appeal (Egan, 2002; Elliott, 2003; Tomlinson, 1996). It is hard to overstate Spencer's influence and Roberts' pronouncement of him as the father of scientific literacy is well deserved.

One of Spencer's (1888) most notable essays is the article and then the chapter 'What knowledge is of most worth', first written in 1859. It is a radical piece of work, as also noted by Eliot, and probably aimed to shake up the traditional view of education. One could summarize Spencer's work as an effort of scientism, since he viewed science as the basis for all decisions, running as the rational current behind all good human behaviour. Such a categorization serves only a limited purpose, however, because there is the danger that such a 'bias' will simply obfuscate the impact he had on Eliot's practice and scientific literacy in general.

Nietzsche (1974, p. 238) similarly commented on Spencer and perhaps most clearly demarcated and enunciated the problem with Spencer's position in terms of the problematic of the Man of Science:

> 'Science' as prejudice – It follows from the laws that govern rank ordering (*Rangordnung*) that scholars, insofar as they belong to the intellectual middle class, are not even allowed to catch sight of the truly great problems and question marks; moreover, their courage and eyes simply don't reach that far…. What makes, for instance, the pedantic Englishman Herbert Spencer rave in his own way and makes him draw a line of hope, a horizon which defines what is desirable; that definitive reconciliation of 'egoism and altruism' about which he spins fables.

The following now illuminates Spencer's (1919) statements from his essay 'What knowledge is of most worth', specifically focusing on his thoughts on moral discipline and his template for Being-Scientific and how scientific knowledge should be positioned in society. Spencer's thoughts are only vaguely linked, through his template of the citizen/Man of Science, but never incorporated in, the discursive formation of Democracy. Spencer's thoughts regarding democracy/society and citizenship were not compatible with the discursive formation of Democracy at that time and he was considered a radical and a counter-discourse to the traditional notions of Democracy. Spencer was thus a great mover of thought, a true lunatic, which served as a mirror for other thinkers.

Spencer is thus posited as a clear voice, or discursive thread, of *the manifestation of Vision II* Roberts mentioned, a particularly skewed and misaligned Ouroboros. Spencer's approach, however, is so radical that Vision I had its arbitrary genesis at the same time Spencer's view and discursive formation took shape. In other words, the pure scientism created its own counter-discourse/recessive discourse, akin to Foucault's (1992) studies on pleasure and sex, which could explain why the discursive formation of Scientific Literacy and its transformations have since had their binary conflicted nature.

Spencer and Eliot are treated as two *conceptual personae*. Another way of examining their relationship would be to posit an English influence of thought regarding education and morality towards a new American spirit of unity and reform after the US Civil War. Such an analysis, however, is not the focus here, but one can readily turn elsewhere to see the traces of such an investigation (Egan, 2002; Hawkins, 1972; Tyack and Cuban, 1995).

Constructing the Man of Science

The following exemplifies, enunciates, and vivisects how Spencer's statements create and actualize the specific rationality of the Man of Science (Bang, 2014; Stengers, 2000) and what was seen in later transformations as the reflective citizen or citizen science. This discursive formation is an earlier transformation of Vision II intrinsic in the contemporary conception of scientific literacy.

On moral discipline, Spencer (1888, pp. 49–50) wrote,

> Not only, however, for intellectual discipline is science the best; but also for moral discipline.… Science makes constant appeal to individual reason. Its truths are not accepted on authority alone; but all are at liberty to test them – nay, in many cases the

> pupil is required to think out his own conclusions. Every step in a scientific investigation is submitted to his judgement. He is not asked to admit it without seeing it to be true. And the trust in his own powers thus produced, is further increased by the uniformity with which Nature justifies his inferences when they are correctly drawn. From all which there flows that independence which is a most valuable element in character.

This is an example of the connection Spencer made between science and forms of moral discipline. The pupil becomes independent and a true scientist by testing scientific truths in his or her own investigations. These powers are again reinforced when Natures justifies a correctly drawn interference. The discursive thread regarding the scientist is a typically modern take on the character and independent ascetic attitude of the scientist. One notes obvious relations to similar statements, such as 'the truth shall set you free', 'truth is connected to independence', and 'the truth is found in Nature'. The Ouroboros has never been posited before with such an appetite.

However, Spencer does not stop at such almost contemporary statements regarding science, truth, and independence. He draws scientism to its full conclusion and mimics, therefore, in a sense, the dark side of Auguste Comte's thoughts on secular and religious society based on positivism while, in the same breath, criticizing him (Comte, 1891; Spencer, 1919; Wernick, 2001).

Spencer (1888, pp. 50–51) wrote, again in relation to the moral discipline of science,

> Lastly we have to assert – and the assertion will, we doubt not, cause extreme surprise – that the discipline of science is superior to that of our ordinary education, because of the *religious culture* that it gives. Of course we do not here use the words scientific and religious in their ordinary limited acceptations; but in their widest and highest acceptations. Doubtless, to the superstitions that pass under the name of religion, science is antagonistic; but not to the essential religion which these superstitions merely hide. Doubtless, too, in much of the science that is current, there is a pervading spirit of irreligion; but not in that true science which as passed beyond the superficial into the profound.… So far from science being irreligious, as many think, it is the neglect of science that is irreligious – it is the refusal to study the surrounding creation that is irreligious. [my emphasis]

This statement of Spencer is crucial in understanding how far his view extends science and the new manifestation of the rationality of the Man of Science and its specific configuration of the rationalities (the Helix and Momentum) within. Science becomes religion, the all-encompassing whole, and Spencer's true a priori is given in the laws of Nature, which becomes science, and upon these all other knowledge must be founded. The religious culture of science thus becomes all encompassing and directly conflicts with the value of independence and truth, which only exist within the frame of Spencer's Nature/science. In other words, Spencer constructed and actualized, or added to, since he was not the origin, a specific rationality regarding the Man of Science related to Being-Scientific.

This ideal archetype, a part of the very frame of the discursive formation of scientific literacy, becomes the blueprint from which all pupils and education shall henceforth be judged. Spencer's Man of Science pursues with religious conviction investigations towards a specific scientific truth in conjunction with the laws set down by Nature itself. In other words, his rationality of the Man of Science becomes associated with asceticism and religiousness: 'By accumulated experiences the man of science acquires a thorough belief in the unchanging relations of the phenomena – in the invariable connexion of cause and consequence – in the necessity of good or evil results' (Spencer, 1888, p. 51).

The above stands as a formulated scientific literacy in the 19th century, accumulated through experience, 'in the necessity of good or evil results':

> Thus the question we set out with – What knowledge is of most worth? – the uniform reply is – Science. This is the verdict on all accounts.… We have not to estimate the degrees of importance of different orders of human activity, and different studies as severally fitting us for them; since we find that the study of Science, in the most comprehensive meaning, is the best preparation for all these orders of activity. (Spencer, 1888, p. 53)

No wonder Nietzsche considered Spencer an enemy. It almost as if the science and knowledge Spencer proposed was anathema to Nietzsche's thought and notion of spirit. Science has, in the conceptual persona of Spencer, become the new altar, the new idol, to worship, believe in, and bow before. The next section returns to Eliot's position to enunciate

the other pole in the discursive formation of scientific literacy and the other manifested and actualized template of Being-Scientific/Man of Science.

Charles W. Eliot's noble science

Eliot was president of Harvard from 1869 to 1909 and the drive and engine behind its transformation from a polytechnical college to an Ivy League institution and university (Hawkins, 1972; Katz, 2009). Harvard became a blueprint and idealized model towards which other universities would strive (Hawkins, 1972). In addition to universities and other tertiary forms of schooling, secondary schooling was similarly influenced by the new Harvard standard; thus Eliot's ideas and reforms were generally hailed through the American post-civil war education system as a whole (Tyack and Cuban, 1995). The following enunciates, through the statements of Eliot, the specific kind of scientific/classical literacy he tried to promote, inspired by and in reaction to Spencer's ideas. Spencer and Eliot were never directly opposed in their views regarding scientific literacy but, rather, two shades of the same line of the 'diagram of the outside of thought' regarding science and knowledge. In many ways, Eliot generally manifested and differentiated in the real institutions of America Spencer's actual ideas in the conditions of possibility in Harvard and American post-civil war schooling. There is, however, sufficient divergence between Eliot and Spencer, to argue for them being different proponents and poles of Scientific Literacy: one advocating the radical Vision II and the other the moderate Vision I, still contained within the same overall formation and thought of Scientific Literacy but actualizing two divergent templates of the Man of Science. Notably, one sees how a notion of democracy affirms itself in Eliot's thoughts, far from Spencer's (1916) notion of democracy and vision of society in *Man versus State*.

Eliot's (1869, p. 215) early writings in the *Atlantic Monthly* clearly stated his noble ideal of education and the kind of literacy it should promote:

> The practical spirit and the literary of the scholastic spirit are both good, but they are incompatible. If commingled, they are both spoiled.…The classical course will hurt the scientific, and the scientific the classical. Neither will be at its best.

Eliot's vision is well defined: there is a need for a demarcation between classical studies and scientific studies, especially in the polytechnical colleges. There is thus a similar demarcation between Eliot views of classical literacy and scientific literacy.

Eliot's (1869, p. 220) reasons are drawn from contemporary manifestations and realizations, the Map, and the non-discursive practices witnessed in America:

> All the scientific schools of the country, whether connected with colleges or not, have suffered from the fact, that boys and young men who, from lack of wit or vigor, were found incompetent to pursue the usual classical studies of the preparatory school or the college, turned to the loosely organized scientific schools as safe harbors for their laziness or stupidity.

Eliot thus proposed a new organization, a new demarcation between the classical studies and science subjects in all educational institutions in the country. His task seemed to purify the befuddlement of education and to organize the various institutions into clearer lines of specialized study. Eliot's (1898, p. 3) inaugural address at Harvard stressed this demarcation:

> Not nature, but an unintelligent system of instruction from the primary school through the college, is responsible for the fact that many college graduates have so inadequate a conception of what is meant by scientific observation, reasoning and proof.… There is a method of thought in language, and a method in mathematics, and another of natural and physical science, and another of faith. With wise direction, even a child would drink at all these springs.

This spirit of demarcation between the subjects, of organizing and specializing the students in their respective fields, imbues all of Eliot's writings and efforts in educational organization. There is an aristocratic asceticism, a noble ideal, and a rarefied belonging or elitism to education that should be fostered through a specific spirit of instruction promoting a specific kind of Being, actualized in Eliot's rationality of the Man of Science: 'A university keeps alive philosophy, poetry and science, and maintains ideal standards. It stands for plain living against luxury, in a community in which luxurious habits are constantly increasing and spreading' (Eliot, 1901, p. 246).

Eliot's (1901, p. 409) statement regarding democracy shows exactly how a notion of democracy and a vision of the state entered his notion of education and scientific/classical literacy:

> The vague desire for equality in a democracy has worked great mischief in democratic schools. There is no such thing as equality of gifts, or powers, or faculties, among either children or adults. On the contrary there is the utmost diversity.… The pretended democratic school is fighting not only against nature, but against the interests of democratic society.

One can thus see that Eliot's vision is intended to assimilate the individual spirit into its own diversity: 'Another important function of the public school in a democracy is the discovery and development of the gift or capacity of each individual child' (Eliot, 1901, p. 408).

It is notable how Eliot's vision resonates with modern and contemporary views of education and the overall statements regarding PISA06 (OECD, 2007). On the specific noble ideal of his visions for literacy, Eliot (1901, p. 407) wrote

> From the total training during childhood there should result in the child a taste for interesting and improving reading, which should direct and inspire it subsequent intellectual life.… Guided and animated by this impulse to acquire knowledge and exercise his imagination through reading, the individual will continue to education himself all through life.

Eliot (1901, pp. 417–418) summarized and categorized all the above in the democratic nobility fostered within a democratic school:

> Finally, the democratic school must teach its children what the democratic nobility is. The well-trained child will read in history and poetry about patricians, nobles, aristocrats, princes, kings, and emperors, some of them truly noble, but many vile.… He will see what immense virtues these personal loyalties have developed, even when the objects of loyalty have been unworthy, and he will ask himself, 'What are to be the corresponding virtues in a democracy?' The answer is, Fidelty to all forms of duty.

Eliot's nobility becomes the template the State, as caretaker of the democratic school, should strive towards his specific enunciation of the Man of Science:

> The children should learn that the democratic nobility exists, and must exist if democracy is to produce the highest types of character; but that it will consists only of men and women of noble character, produced under democratic conditions by the combined influences of fine inherited qualities, careful education and rich experience. (Eliot, 1901, p. 418)

To summarize, Eliot's view of scientific literacy is one of a pure demarcation and rarefaction that is to exist within a specific type of democratic school. One thus sees a clear connection to the discursive formation of Democracy and how it has become enveloped within scientific/classical literacy, a notion of democracy that is anathema to Spencer's vision. Eliot (1901, pp. 89–122) referred to his vision as a liberal education highlighting the virtue of liberty in education (Eliot, 1901, pp. 123–148). The manifestation of a dichotomy and demarcation between scientific and classical literacy for Eliot became deterritorialized by political, judicial, and similar structures of the State. Eliot (1901, p. 247) clearly states that 'a university is in all countries a patriotic institution'.

The transformations of Scientific Literacy

The two poles of the discursive formation of Scientific Literacy have been laid out and vivisected. These poles do not succeed or replace each other through different instances in time, but exist within the same discursive formation of Scientific Literacy. Eliot's Vision, manifested and actualized in his template of the Man of Science, is the one that has become the most manifested, most real, and most institutionalized, especially in America, later subtly transformed by John Dewey (1916, 1938; see also Popkewitz, 2005, 2008). Spencer's vision acts as a counter-discourse and shows its voice in discussions, writings, and curricula, especially in the United Kingdom. Thus, when the emphasis on science and scientific literacy resurfaced in America and was later taken up in Europe, it was within that discursive formation frame – transformed, of course – but the inner intrinsic problematic of the Ouroboros still festers.

Wormholes to the present

After examining and exposing the discursive formation of Scientific Literacy in three instances, two historic and one contemporary, one thus returns to the present problematic. This article has shown,

through statements in PISA06, contemporary research in scientific literacy, and Spencer's and Eliot's writings, how democracy gets eaten by the Ouroboros and engulfed in the discursive formation of Scientific Literacy, which, from its arbitrary beginning, has been polarized regarding the Man of Science. In PISA06, the OECD and subsequent nation states are precisely testing to see if students have the adequate scientific knowledge and if they are within the desired template of the reflective citizen/citizen science, thus enacting a necessity, a natural link, between Democracy and Scientific Literacy. This is all done in the name of comparison, quality, and economic competitiveness. The Ouroboros have never been fatter and Scientific Literacy has turned toward Spencer's Vision II, but it has similarly *devoured* Vision I and engulfed it within a specific new capitalistic Scientism. Visions I and II thus exit side by side in the actualization of contemporary Scientific Literacy. The problematic poles no longer create the tension necessary for the dynamic of the Ouroboros and the abstract machine has almost reached a resting point. Science and its education, are in a state of misaligned *ouroborossification*, a specific form of calcification: scientific knowledge/literacy is no longer destroying itself and its connections, no longer constantly reordering itself and creating change. Science and Scientific Literacy have become the all-whole, extended to infinity, engulfing everything.

Additionally, Scientific Literacy is travelling further and further down the educational system and has now become part of the kindergarten curriculum – all in the name of science (Patrick, Mantzicopoulos, and Samarapungavan, 2009; Science, 1993). The Ouroboros has become a perverse cybernetic worm, transformed through deterritorializationof capitalism. Because what banner does Scientific Literacy wave if not an economic one: a (economic) sustainable Earth, a (economic) productive climate, and a healthy (economic), extended life? Scientific literacy has become a vital component of the higher education arms race (Bang, 2014), a cog in the machine to produce Being-Scientific and subsequently Being-Scientist, enunciating a specific rationality regarding the Man of Science. It is as if we collectively have forgotten what science is or what it could be: a wondrous exploration, madness purified, a pure game of chance, and in close alliance with a specific form of intuition (Bachelard, 1984).

Can Scientific Literacy today still produce, or perhaps foster, the creative scientists of the last century or is education simply a reproduction of a collective kind of scientific sameness? Perhaps there is a way out of the above dismal diagnosis. Benedict Spinoza and Deleuze show that, through reaching a third kind of knowledge and seeing the immanent relation between scientific literacy, knowledge of nature, and knowledge of Spinoza's God in general, one can reconceptualize

scientific literacy and scientific knowledge by seeing the connection between all things (Deleuze, 1990; Spinoza, 1996). But first, there is a need to overturn the Platonic ideals of Science, the Cogito in science education, and inadequate presuppositions and it is hoped that this article can inspire educational researchers to look inward for the Ouroboros within science education with a fresh Image of Thought.

References

Aikenhead, G. (2002). Renegotiating the culture of school science: scientific literacy for an informed public. *Lisbon's School of Science conference*. Lisboa,.

Bachelard, G. (1984). *The new scientific spirit* (A. Goldhammer, Trans.). Boston: Beacon Press.

Bang, L. (2014). Welcome to school - welcome to the Empire-Building Business: an exploration and expansion of Bourdieu's notion of field. *Waikota Journal of Education, 19*(1), 51–62.

Bang, L., & Valero, P. (2014). Chasing the chimera's tails: an analysis of interest in science. In T. S. Popkewitz (Ed.), *The "reason" of schooling. historizing curriculum studies, pedagogy and teacher education*. New York: Routledge

Bybee, R., McCrae, B., & Laurie, R. (2009). PISA 2006: An assessment of scientific literacy. *Journal of Research in Science Teaching, 46*(8), 865–883.

Comte, A. (1891). *The catecism of positive religion*. New York: Cambridge University Press.

Daston, L., & Galison, P. (2007). *Objectivity*. New York: Zone Books.

Daston, L., & Lunbeck, E. (Eds.). (2011). *Histories of scientific observation*. Chicago: University of Chicago Press.

Daston, L., & Park, K. (1998). *Wonders and the order of nature, 1150–1750*. New York: Zone Books.

DeBoer, G. E. (1991). *A history of ideas in science education: implications for practice*. New York: Teachers College Press.

DeBoer, G. E. (2000). Scientific literacy: another look at its historical and contemporary meanings and its relationship to science education reform. *Journal of Research in Science Teaching, 37*(6), 582–601.

Deleuze, G. (1986). *Foucault* (S. Hand, Trans., 2006 ed.). London: Athlone Press.

Deleuze, G. (1988). *Spinoza: practical philosophy*. San Francisco: City Lights Books.

Deleuze, G. (1990). *Expressionism in philosophy: Spinoza*. New York: Zone Books.

Deleuze, G. (1994). *Difference and repetition*. London: Contiuum Group.

Deleuze, G. (2004). *Desert islands: and other texts, 1953–1974*. New York: Semiotext.

Deleuze, G. (2006a). *The fold: Leibniz and the baroque*. New York: Continuum.

Deleuze, G. (2006b). *Nietzsche and philosophy*. New York: Columbia University Press.

Deleuze, G., & Guattari, F. (1983). *Anti-Oedipus: capitalism and schizophrenia*. Minneapolis: University of Minnesota Press.

Deleuze, G., & Guattari, F. (1987). *A thousand plateaus: capitalism and schizophrenia*. Minneapolis: University of Minnesota Press.

Deleuze, G., & Guattari, F. (1994). *What is philosophy?* New York: Columbia University Press.

Dewey, J. (1916). *Democracy and education*. New York: Dover Publications.

Dewey, J. (1938). *Experience & education*. New York: Touchstone.

Egan, K. (2002). *Getting it wrong from the beginning: our progressivist inheritance from Herbert Spencer, John Dewey, and Jean Piaget*. London: Yale University Press.

Eliot, C. W. (1869). The new education. *Atlantic Monthly, 23*, 203–220.

Eliot, C. W. (1898). Inaugural address as president of Harvard College. *Educational reform: Essays and addresses.* New York, The Century: 1-38

Eliot, C. W. (1901). *Educational reform: Essays and addresses*. New York: Century.

Elliott, P. (2003). Erasmus Darwin, Herbert Spencer, and the origins of the evolutionary worldview in British provincial scientific culture, 1770–1850. *Isis, 94*(1), 1–29.

Foucault, M. (1970). *The order of things. An archaeology of the human sciences* (2nd ed.). New York: Routledge.

Foucault, M. (1972). *Archaeology of Knowledge* (A. M. S. Smith, Trans., 1st English ed.). London: Routledge.

Foucault, M. (1992). *The use of pleasure* (R. Hurley, Trans., Vol. 2). London: Penguin Books.

Foucault, M. (1995). *Discipline & punishment: The birth of the prison* (A. Sheridan, Trans.). New York: Random House.

Garrett, G. (1926). *Ouroboros; or, the mechanical extension of mankind*. New York: E. P. Dutton.

Hawkins, H. (1972). *Between Harvard and America: the educational leadership of Charles W. Eliot*. New York: Oxford University Press.

Hurd, P. D. (1958). Science literacy: its meaning for American schools. *Educational Leadership, 16*(1), 13–16.

Hurd, P. D. (1998). Scientific literacy: new minds for a changing world. *Science Education, 82*(3), 407–416.

Hurd, P. D. (2002). Modernizing science education. *Journal of Research in Science Teaching, 39*(1), 3–9.

Jung, C. G. (1968). *Psychology and alchemy. Collected works of CG Jung*. Vol. 12. (R. Hull, Trans.). New York: Princeton University Press

Katz, M. B. (2009). *Reconstructing American education*. London: Harvard University Press.

Kolstø, S. D. (2001). Scientific literacy for citizenship: tools for dealing with the science dimension of controversial socioscientific issues. *Science Education, 85*(3), 291–310.

Laugksch, R. C. (2000). Scientific literacy: a conceptual overview. *Science Education, 84*(1), 71–94.

Lindsay, J. (1970). *The origins of alchemy in Graeco-Roman Egypt*. London: Barnes & Noble.

Mahdihassan, S. (1961). Kekulé's dream of the Ouroboros and the significance of this symbol. *Scientia, 96*(1), 187–195.

Miller, J. D. (1998). The measurement of civic scientific literacy. *Public Understanding of Science, 7*(3), 203–223.

Nietzsche, F. (2005). *The Anti-Christ, ecce homo, twilight of the idols: and other writings*:. London: Cambridge University Press.

Nietzsche, F. (1974). The gay science (W. Kaufmann, Trans.). New York: Vintage Books.

Organisation for Economic Co-operation and Development (2007). PISA 2006 Science Competencies for Tomorrow's World, Volume 1 – Analysis. Washington: OECD Distribution

Patrick, H., Mantzicopoulos, P., & Samarapungavan, A. (2009). Motivation for learning science in kindergarten: is there a gender gap and does integrated inquiry and literacy instruction make a difference? *Journal of Research in Science Teaching, 46*(2), 166–191.

Popkewitz, T. S. (2004). The alchemy of the mathematics curriculum: inscriptions and the fabrication of the child. *American Educational Research Journal, 41*(1), 3–34.

Popkewitz, T. S. (2005). *Inventing the modern self and John Dewey: modernities and the traveling of pragmatism in education*. New York: Palgrave Macmillan.

Popkewitz, T. S. (2008). *Cosmopolitanism and the age of school reform: science, education, and making society by making the child*. New York: Routledge.

Purpus, E. (1954). Scientific and technical literacy. *Journal of Higher Education, 25*(9), 475–478.

Roberts, D. A. (2007). Scientific literacy/science literacy. In S. K. Abell & N. G. Lederman (Eds.), *Handbook of research on science education* (pp. 729–780). New Jersey: Lawrence Erlbaum.

Roth, W.-M., & Barton, A. C. (2004). *Rethinking scientific literacy*. London: Taylor and Francis.

Science, A. A. f. t. A. o. (1993). *Benchmarks for science literacy*. London: Oxford University Press.

Shamos, M. (1995). *The myth of scientific literacy*. New Jersey: Rutgers University Press.

Sheppard, H. J. (1962). The Ouroboros and the unity of matter in alchemy: a study in origins. *Ambix, 10*(2), 83–96.

Spencer, H. (1888). *Education: intellectual, moral, and physical*. London: Adamant Media.

Spencer, H. (1916). *The man versus the state*.Indianapolis: Liberty Fund

Spencer, H. (1919). *Essays on education and kindred subjects*. London: JM Dent.

Spinoza, B. D. (1996). *Ethics* (E. Curley, Trans.). London: Penguin Group.

Stengers, I. (2000). *The invention of modern science* (D. W. Smith, Trans.). Minneapolis: University of Minnesota Press.

Tomlinson, S. (1996). From Rousseau to evolutionism: Herbert Spencer on the science of education. *History of Education, 25*(3), 235–254.

Tyack, D. B., & Cuban, L. (1995). *Tinkering toward utopia: a century of public school reform*. Boston: Harvard University Press.

Wernick, A. (2001). *Auguste Comte and the religion of humanity: the post-theistic program of French social theory*. Cambridge: Cambridge University Press.

Whitehead, A. N. (2011). *Science and the modern world*. Cambridge: Cambridge University Press.

[0] ENTER THE VOID

> “The most merciful thing in the world, I think, is the inability of the human mind to correlate all its contents. We live on a placid island of ignorance in the midst of black seas of infinity, and it was not meant that we should voyage far. The sciences, each straining in its own direction, have hitherto harmed us little; but some day the piecing together of dissociated knowledge will open up such terrifying vistas of reality, and of our frightful position therein, that we shall either go mad from the revelation or flee from the deadly light light into the peace and safety of a new dark age.”
>
> (Lovecraft, 2002, p. 139)

> “The void is itself the paradoxical element, the surface nonsense, or the always displaced aleatory point from whence the event burst forth as sense.”
>
> (Deleuze, 2004b, pp. 155-156)

> Whoever fights with monsters should see to it that he does not become one himself. And when you stare for a long time into an abyss, the abyss stares back into you.
>
> (Nietzsche, 2002, p. 69)

[0,1] THE LAST AND FIRST MOMENT OF NON-SENSE WITHIN THE EMPTY SQUARE

The Void, is the beginning and end of everything in the labyrinth. The Structuralist Hero freely floats among the flotsam of monstrous debris of intensities, residing inside the maw of the Ouroboros and the Empty Square of Science. Other monsters are chained here as well: The Chimera roars eerily, continuously shifting and transforming in the distance, enormous and encapsulating whole regimes of Thought. The Gorgons have their own constellation here and their gaze extends to everywhere and no-where. The Cerberus guards the exit and entry here, only the dead, pure of spirit, may enter, to never depart. Here the [Structuralist Hero] can gaze upon himself and see the shadow, which have been trailing him, following the bloody umbilical cord: The Minotaur, and its evident structure looms as if to include and incorporate the hero within itself.

[1,1]´´ IN THE BEGINNING THERE WAS INTENSITY

Everything starts with intensities; they are the treasured Key of Salomon, which reveals Deleuze's movement of Thought. Everything from the 'ground and up' consists of systems of intensities.

> The intensive character of the systems considered should not prejudice their being characterized as mechanical, physical, biological, psychic, social, aesthetic, or philosophical etc. Each type of system has undoubtedly has its own particular conditions, but these conform to the preceding characteristics even while they give them a structure appropriate in each case: for example, words are genuine intensities within certain aesthetic systems; concepts are also intensities from the point of view of philosophical systems. (Deleuze, 1994, p. 144)

To glimpse upon Becomings in Science one must thus turn to towards the swarm of intensive processes and the pre-individual, towards an intensive Science (DeLanda, 2013). Deleuze's individuation is inspired by Gilbert Simondon's Theory of Individuation (Bowden, 2011). Deleuze has a specific notion of the 'individual in intensity' (Deleuze, 1994, p. 322), which Sean Bowden calls the 'divided subject' consisting of a dissolved Self and a fractured I. This 'divided subject' exists in the field of individuation and it is in the relation between the dissolved Self and the fractured I one finds individuation.

Intensity is spread in Extension and covered up. It is here the great illusion and masquerade of the 'fractured I' begins. Because when this 'divided subject', the dissolved Self and the fractured I, becomes differenciated, actualized as the I, which acts as the psychic determination of the species and the Self becomes the organization. Thus was the illusion of the Cogito birthed.

> With psychic systems the problem assumes a particularly urgency, since it is by no means certain that either the I or the Self falls within the domain of individuation. They are, rather, figures of differenciation (…) The I therefore appears at the end as the universal form of psychic life, just as the Self is the universal matter of that form. The I and the Self explicate one another, and do so endlessly throughout the entire history of the Cogito. *The individuating factors or the implicated factors of individuation have neither the form of the I nor the matter of the Self* (Deleuze, 1994, pp. 319-320, my emphasis)

This Cogito, which recently exists in the Cartesian form, perhaps supplied with a contemporary perverse form of Neuro[tic] Science, is a great adversary and obstacle. It is a source of so much confusion, punishment, regimes and societies of

control. The Cogito drags a bloody trail throughout history, where man has punished and bloodletted man in the name of Stupidity.

Deleuze point towards Nietzsche as the (re)discoverer of the Abyss the one who paved the way for recognizing the 'divided subject' and the 'individual in intensity'

> The great discovery of Nietzsche's philosophy, which marks his break with Schopenhauer and goes under the name of the will to power or the Dionysian world is the following: no doubt the I and the Self must be replaced by an undifferenciated abyss, but this abyss is neither an impersonal nor an abstract Universal beyond individuation. *On the contrary, it is the I and self which are the abstract universals. They must be replaced, but in and by individuation, in the direction of the individuating factors which consume and which constitute the fluid world of Dionysus. What cannot be replaced is individuation itself.* (Deleuze, 1994, p. 321, my emphasis)

Deleuze's individual is thus not a subject but a Haecceity (Deleuze & Guattari, 1987; Parr, 2010) it has a specific character, caveat emptor, of the individual in intensity.

> A degree, an intensity, is an individual, a Haecceity that enters into composition with other degrees, other intensities, to form another individual. (Deleuze & Guattari, 1987, p. 253)

Education has not even begun to glimpse upon such a new conceptualization of 'man' in Extension, or perhaps it is no longer a 'man' but simply bare life contained within striated space. [n,n+1] - [55,89]´- [55,89]´´-[55,89]´´´

[1,2]´´ EPILOGUE: THE GAZE OF THE GORGONS/MEDUSA

As the Structural Hero leaves the Void the constellation of the Gorgons begins to move. Their abject, too masculine gaze, follows the hero like a simmering heat vision, imploring the Structural Hero to set the gaze free and unleash its perspective upon Science and its Education.

> I've seen things you people wouldn't believe. Attack ships on fire off the shoulder of Orion. I watched C-beams glitter in the dark near the Tannhauser gate. All those moments will be lost in time... like tears in rain... Time to die. (Scott, 1982, statement of Batty (an android))

[1]´´ THE CAVERN OF THE CHIMERA

[1,1]´´´ THE NORTHERN PASSAGE OF NONSENSE

After escaping the Empty Square the Structural Hero finds himself constantly going north, his compass is clear. North, always north the labyrinth takes him until he reaches the coldest part of the maze. He arrives at a cavern covered in a crust of ice The front of the cavern is coated with frosted blood and leftover skin, inside the Chimera roars in pain. As the wayward hero enters the cave he stumbles over the skin, earlier incarnations of the Chimera, which have been shed to give way for new forms and transformations. The Chimera is luckily chained in the back of the chain, not by a strong Godly chain but by a small cord, a cable which both transforms the Chimera and holds it in place. This incarnation of the Chimera is a true monstrosity. Its form is caught in a cybernetic flux: the head is at the same time the tail and the body, everything is connected flawlessly, enveloped in each other and underneath it all green bits of data shimmers. The Structuralist Hero, with no weapons available, bites open a vein and drips blood onto the cord hoping the infusion of blood and bodies will somehow release the monster. To no avail the blood poured is transformed into a silvery liquid paste and while pouring the hero realizes he himself is in danger of becoming cybernetic and static, he withdraws his arm and leaves the Chimera, which roars in defiance. As the hero leaves the cave he swears a wow to return, to unleash the monster, to set it free to take avenge upon captors.

> I'm friends with the monster that's under my bed
> Get along with the voices inside of my head
> You're trying to save me, stop holding your breath And you think I'm crazy, yeah, you think I'm crazy
>
> (Eminem, 2013c, The Monster)

[1,2]´´´ THE SECRET DOOR INTO AN EARLIER CHIMERA

There is a specific omission in the published chapter containing the Chimera, which ended up being too thin, too un-Mapped and seemingly only connected by postulate. Luckily there has been recovered the lost map of the Chimera, which connects and maps more explicitly the map of Prussia and America showing the rearing cage of some of the manifestations of the Chimera - linking the living concept to the Map.

[2,3]´´ ADDENDUM TO THE CHIMERA - THE SECRET MAP OF PRUSSIA & AMERICA

The addendum [2,3]´´- [8,13]´´should thus be inserted and read directly after page 57 (of the thesis) and the addendum [13,21]´´directly after page 60 (of the thesis).

[3,5]´´ THE REARING CAGE OF HERBART'S CHIMERA - PRUSSIAN DISCIPLINATION

The three discursive rationalities forming The Chimera of Herbart and his notion of Interest in Science are: The Measurement, The Mind/Soul and The Moral. The rationalities in Herbart's writings are the discursive formations of the chimera-construct. In the following gaze is turned to the specific non-discursive formations and the manifested practices that the intersected rationalities are enacted within and without. When mapping the diagram of The Chimera – the Interest in Science - one needs to turn the gaze to its cage and rearing conditions – the institutional conditions of possibility.

Herbart's ideas regarding mathematics, psychology and education were unrecognized in his present, he was very much a 'voice in wilderness' amidst the Hegelian and Kantian thoughts (Dunkel, 1970). Dunkel (1970) shows clearly, that Herbart's role in educational science is the role of the ghost, only appearing once in a warped form of his writing (Herbartianism) and then disappearing again.

In the gaze invoked here Herbart's thoughts and ideas represents a kind of counter-discourse to the mainstream Prussian educational discourse, which was interested in mass schooling, not Herbart's pupil-mentor relationship. What is interesting though from the strata of the Archive is two fold: 1) Why did Herbart's ideas came about in that specific historical contingency? 2) What were the other discourses regarding education, the ones to which Herbart was a counter to? 3) And lastly what happened to Herbart since he, in contemporary research, has become recognized as a milestone in the development of the concept Interest in Science (Krapp & Prenzel, 2011)?. In other words how was Herbart transformed from oblivion to a founding father regarding interest in science?

Herbart's Prussia in 1829 was the culmination of an idea of wholeness put forth in theory in the 18th century, transformed through various power struggles and invoked with Süvern's law of 1819 (Schleunes, 1979). To outline this 'marvelous' progression one event stands out as a catalyst – the battle of Jena 1805; the sort of event Foucault refers to as eventalization (Foucault, 2000, p. 226). This loss and humiliation by the upstart Napoleon, by the new regime of revolution and equality, marked a catalyst in negativity to the ancien regime, which through laws and bureaucracy cast new frames for the institutions and population of Prussia, making

parts of Herbart's recessive discourse (his specific disciplination and repetition) the dominant and enacting Herbart's specific Being-Chimera, as a particular ideal mold of man. The rationalities in The Chimera and how they are connected in the Diagram is thus a manifestation of a unique Prussian form of disciplination, connected to the practices of the Prussian state and specific 'spirit' (Melton, 2002), which again is manifested in the curriculums for the teachers, where the ideal discipliner is put forth as a contradiction invoking a necessary Dark Side of Pedagogy or of failed educational science due to the missing link between The Morality and The Mind/Soul and The Measurement.

[5,8]´´ A PRE-JENA DISCURSIVE THREAD OF PIETISM AND JESUIT CATHOLICISM

Before Jena there had been a discourse, a simmering notion, but only with limited institutional manifestation in Prussia, regarding the opportunity to educate the lower masses. In part, this discourse was inspired by Heinrich Pestalozzi's work and writings in Switzerland, but also as a larger discourse connected to the new era of Enlightenment and the new ideal of man (Foucault, 1970; Schleunes, 1979). A manifestation of this discourse was enacted in Prussia in the work of the philanthropist Baron Von Rochow, who experimented with the educational ideas of Pestalozzi on his peasants in his own estate in Brandenburg (Schleunes, 1979). Rochow introduced an estate-based system, which had the explicit aim of turning peasant children into patriots (Gagliardo, 1969), the system though needed means to go beyond the estate and into the state, which before Jena wasn't prioritized by the administration.

The pre-Jena discourse was intersected with pietism, as seen in the edict of 1763 'The General-Landschul-Reglement'. In this edict the schoolmaster's role was to break the will of the child and to cultivate diligence and obedience, he was to bring forth issues of corporal punishment to the pastor, who also acted as overseer of the schools. To achieve the aim of educating the masses one crucial part was missing, and the main reason it had limited practical effect, the edict lacked discipliners - educated schoolmasters. The disciplination of the discipliners for the schools was the centre of interest for Frederick II and his chief minister Brenckenhoff. The solutions seemed very costly, but an interesting idea and discourse arose in 1779 – a seemingly brilliant fusion of the means and the goal of education of the masses: retired or disabled army veterans should handle the education. Frederick's new teacher institutes couldn't sufficiently handle the immanent needs for teachers if the idea of compulsory schooling should be more than a fanciful idea; therefore this simple solution was put forth. The Prussian solution of army veterans as schoolteachers failed though due to military needs overshadowing the pedagogical goals and bureaucratic resistance, thus before Jena the results were meek, as Melton (2002) showed in his research.

What is important to grasp is perhaps why the uniformity of the compulsory schooling was needed for the Prussian concept of state, one that was forced to transcend religion. Pre-Jena, two discursive threads of compulsory schooling were being enacted and experimented with, a protestant and a catholic thread entwined in a complex pattern. The first strain was the pietistic theologian and educational thinker Johann Julius Hecker. Hecker stressed the needs for educated schoolmasters and whose institute first introduced group teaching of children instead of teaching a single child in Germany (Melton, 2002); The second thread was the abbot and pedagogical thinker Johannes Ignaz Felbiger. Both Melton (2002) and Schleunes (1979) state that the influence of Felbiger went beyond catholic reforms and before the dethroning of Johannes Ignaz Felbiger (due to his meddling in military affairs) his ideas of practice and education were in ascendance.

Thus the axis of Protestantism and Pietism (exemplified by J.J. Hecker) and Jesuit Catholicism (exemplified by J.I. Felbiger) was the 'spirit' and discourse of reform pre-Jena, both set upon a single solution: Educated discipliners. The pietistic pedagogy was a perfect tool in instructing the masses of children and was cultivating a work ethic, which suited the needs of the state (Melton, 2002)

In 1794 the state took firm control over the schools with the "New General Civil Code" and thus ended the divide in between protestant and catholic schooling on paper (Schleunes, 1979).

[8,13]´´ A POST-JENA DISCOURSE – BUILDING THE FRAME FOR THE PRUSSIAN DISCIPLINATION

The disaster of the battle of Jena and the Peace at Tilsit in 1807 left Prussia reduced to 50% in size and population and under occupation. Prussia underwent a succession of reformers and a first manifestation could be seen in the Edict of Emancipation, which introduced the notion of 'a free people' in 1807 (Schleunes, 1979). The symbolic head of the educational reform was Humboldt. Yet, in work and deed it was Prussian bureaucrats and legislators who made the frame. Two persons were instrumental in the reform leading to the school bill in 1819: 1. G.L. Nicolovius, who insisted on teacher teaching and picked up the discourse pre-Jena and wanted to introduce Pestalozzi's ideas in the Prussian school system. 2. J. W. Süvern a neo-humanist, professor from Königsberg and head of the Section's division of Gymnasium affairs expanded Nicolovius' ideas.

Süvern made a seemingly brilliant plan, which exemplifies the scope of the educational reform and the means taken to ensure it. He wanted to turn orphanages into teacher-institutes and the orphans into teachers – with one stroke solving two problems of the state (Schleunes, 1979). The execution of the idea of Süvern was put into the hands of K. A. Zeller, the apprentice of Pestalozzi and presumably a Wunderkind of proportions, who started the Normalinstitut in Königsberg by

transforming the first orphanage into a teacher manufacturing institution. The experiment of Zeller was a failure and received unwanted attention and investigation. As Schleunes formulates it:

> "But when investigation revealed a terroristic regime of spiritual-psychological purgings of children in the late-night darkness of the chapel, there was no choice but to have Zeller retired."(Schleunes, 1979, p. 328)

After the illumination of the pestalozzian method in the form of Zeller the road was paved for Humboldt's successor Natorp to introduce Seminars. By 1819 ten seminars had been established, staffed with students from Pestalozzi and based out of former monasteries (Schleunes, 1979). The methods exercised were still in the disciplinary line of Pestalozzi, but a new discourse of wholeness and totality had entered the educational regime. A practice of a specific kind of Prussian disciplination was being shaped.

Süvern's school bill of 1819 shows the discourse for wholeness. The subsequent conservative rejections to the reform were published in 1825 by Beckedorff in a essay "Concerning the Concept of Volksschule" showing the other side of the discourse (Schleunes, 1979). In Prussia there was a discourse, whose binary parts are enacted within the very institutions. At same time the seminars and the discipliners must be: a) bearers of Pestalozzi's ideas and the enlightenment project - the positive move forward b) promoting a hierarchy of the state and estates – securing the old world order through a more efficient state and more dedicated soldiers; both notions were visible in the curriculum of the seminars (Schleunes, 1979). This new schizophrenic discipliner for the new age of Prussia is the result of the above conflicts, and the disciplination bore the mark of that attempt to fuse two discourses, who were each other's opposites. The schizophrenic discipliners were the children of The Chimera, heirs to the new diagram in a foucauldian sense (Deleuze, 1986). A new pedagogy and rationality was needed to overcome this schizophrenia and Herbart's writings can be seen as an effort to overcome that gap, though with limited practical implementation.

Let's return to the proposed discourses intersecting Herbart's concept of Interest in Science and how it is specifically linked to the above conflict in the institutions and legislations of Prussia.

Schleunes is proposing that the usual trinity of concepts operationalized to understand mass schooling in general is inadequate in explaining the particular 'strive for wholeness' so visible and inherent in the Prussian history of 1750- and beyond (Schleunes, 1979). My argument is that by superimposing the discourses contained and transversing The Chimera with the concepts of Schleunes and traditional analysis (thereby linking the discourses intersecting Herbart's Chimera

with historical notions) we get a fuller glimpse of the 'strive for wholeness', which is attributed as being unique to Prussia: 1) Social control – The Mind 2) Modernization/Industrialization - The Measurement 3) Integration - The Morality. To summarize, the rationalities in The Chimera construct is thus a manifestation of a unique Prussian form of disciplination, connected to the practices of The State, which again is manifested in the curriculums for the teachers, where the ideal discipliner is put forth as a binary contradiction.

[13,21]´´ DEWEY'S WHITE ELEPHANTS – THE AMERICAN BREEDING OF INTEREST IN EDUCATION (SCIENCE)

In the following, the specific discursive formations and rationalities from Dewey's Chimera will be traced to the non-discursive formations and practices. In other words the frame of the specific Chimestry, which makes The Chimera of Dewey possible. Dewey's influence on the American school reform is hard to overlook, both as an active and reactive catalyst. The henchmen of Dewey (The White Elephants), set on changing the American School System, picked up Dewey's ideas and began a struggle for implementing them, all in the name of progress:

> "During the first half of the twentieth century, the chief American architects of reform and arbiters of educational "progress" constituted a policy elite we call the administrative progressives. These reformers were a group unified by similar training, interests and values. They were the first generation of professional leaders educated in the new schools of education." (Tyack & Cuban, 1995, p. 17)

These White Elephants were all carrying the discourse of Dewey into the growing administration of the American educational system, such as The National Education Association (NEA), and by occupying key positions they set upon changing education and making it a force for building a just democratic society and a cosmopolitan citizen (Popkewitz, 2005, 2008; Tyack & Cuban, 1995)

The new word was education as an 'educational science' or as Tyack and Cuban (1995) conceptualized it 'progress and education as an ideology.' The Chimera of Dewey shows us this specific entry of educational science regarding the rationality of The Measurement in Dewey's conceptualization of Interest in Science and Education. Specifically a set of binary discursive formations arose from the new conceptualization of The White Elephants - Progress vs. Regress. In 1919, the U.S Bureau of Education issued A Manual of Educational Legislation, the blue print for standardization. The blueprint carried with it the discourse of cosmopolitaniism and liberalism in the differentiation of the singular pupil, and (if one is bold) a warped version of Dewey's discourse on education:

> “Basic to their conception of educational science was a conviction that children had different abilities, interests, and destinies in life. Hence schools should treat them differently; this was their concept of equality of educational opportunity. They gave different labels to students who did not fit their definition of “normal”, and they created tracks and niches for them. Progress to these experts meant a place for every child and every child in his or her place.” (Tyack & Cuban, 1995, p. 20)

Like Herbartianism being a warped form of Herbart’s writings (Dunkel, 1970) the American School reform (the march of progressivism) can be seen as a warped manifestation of Dewey’s ideas and principles, and enough warped to inspire him to write a critique on this progressivism in his book *Experience and Education* (Dewey, 1938). Dewey’s binary linked Chimera was thus instrumental for the progressives and the link Dewey made between The Moral and The Mind was critical. What is interesting in the conceptualization of this article is that in Dewey’s critique and remarks to the progressives in 1938 he stresses the needs of the scientific method being the base of educational science (see earlier quote) thus sowing the seed for the next Chimestry and ultimately leading the to the contemporary form of The Chimera. The Chimera of course undergoes several other Chimestry’s in the following decades to arrive to the contemporary form in PISA. Especially the rationalities regarding The Mind and The Measurement are being transformed by Berlyne’s notion of interest and motivation (Berlyne, 1949, 1965) and Gardner’s conceptualization of psychometrics in regards to interest (Gardner, 1975a, 1975b). The educational conceptualizations undergo sweeping changes and simultaneously educational institutions are changed through the march of capitalism and neoliberalism – schools becoming part of the global educational arms race.

[21,34]´ ARTICLE – CHASING THE CHIMERA'S TAILS – AN ANALYSIS OF INTEREST IN SCIENCE

9

CHASING THE CHIMERA'S TAILS

An Analysis of Interest in Science

Lars Bang and Paola Valero

abyssus abyssum invocate
"deep calleth unto deep"
Psalms 42:7

Science Education and Being

Education produces specific desired expressions of Being. Nowadays we are surrounded by discourses stating that it is necessary and good for students to be interested in science and that *interest in science* leads to effective learning and to scientific literacy. Thus, through science education, the student is transformed into a citizen or even a scientist—if he or she has the skills and aptitudes in that area. In a world where "the economy is increasingly driven by complex knowledge and advanced cognitive skills" (OECD, 2006, p. 3), the more natural scientists—and technologists, engineers, and mathematicians as well—society produces, the better economic competitiveness, progress, welfare, and enlightenment there will be for all. Science education, Being, and Becoming are linked in inexorable ways.

Problematizing the apparent force and unquestionable causality of these types of statements with tools from Foucault and Deleuze, the question explored is how scientific rationalities affect subjectivity and Being. Being-Scientist[1] is often portrayed as a monolithic, unified conceptual unit emerging from the particular universal enlightenment of reason. It is the purpose here to show that the constitution of the Being-Scientist has been effected in subsequent transformations taking place early in modernity as the sciences became differentiated and specialized (Daston & Galison, 2007). Thus Being-Scientist consists of ruptures and particular fragments rather than a uniform conceptual unit. It is composed of many different amalgamated rationalities, which often appear assembled in specific formations or

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hybrids, like a plethora of monsters; monstrous due to the often contradictory—still connected—construction of these particular formations.

One of these forms of Being-Scientist, namely the being who is driven by the *interest in science*, is identified and constructed as a new image of thought (Deleuze, 1994) for capturing one of these historical transformations in modernity. *Interest in science* is a concept that, since the PISA survey in 2000 (OECD, 2004) and the "interest" survey in 2006 (OECD, 2007), has been given a lot of attention internationally. The research in *interest in science* (e.g., Krapp & Prenzel, 2011) has spawned numerous projects (e.g., Sjøberg & Schreiner, 2010) and initiatives (e.g., OECD, 2006) to improve and facilitate youth's engagement with learning science and choosing a STEM course of study in higher education.

The mythical Greek *chimera* is used as the amalgam, hybrid, and new image of thought to explore and explain the folding and unfolding of how the construct Interest in Science frames a particular fragment of Being-Scientist. The mythical chimera is composed of a lion's head, a goat's body, and a serpent's tail. Its different animal traits changed place in various subsequent historical depictions. Sometimes the serpent would be the head, the lion the body, and the goat the tail. Like the chimera, the construct of Interest in Science transverses several discursive formations and adopts different forms in time and space. The process that leads to these transformations and reconfigurations of the chimera will be labeled *Chimestry*, as a nomenclature of the practices and events leading up to a transformation or a diagrammatic shift (Deleuze, 1986), though not enacting a direct causality.

The historical and contemporary discursive shifts of Being-Scientist are explored through the hunt of the Chimera, by positing the Archive, the Map and the Diagram of the various epochs in a new image of thought of the Chimera

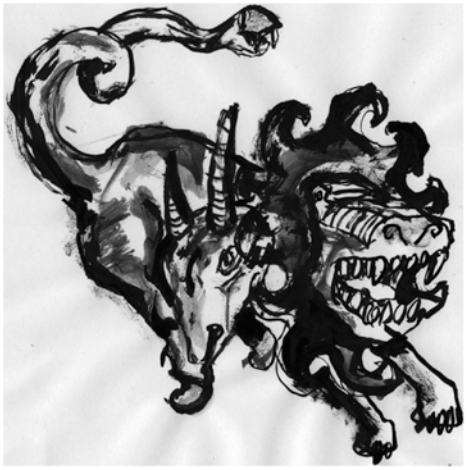

PHOTO 9.1 The Chimera v. Anders Bang

(see Figure 9.1). The hunt pursues two particular claims, which are critical in understanding the power effects of contemporary science education. The first claim is that educational research in *interest in science* is framed by particular formations of discourse—rationalities—that shape and ultimately limit the way research itself and educational practice address the concept and inherent problem of *interest in science.* Contemporary educational research in science education draws on three problematic premises:

1. Proposing a causal relationship between students' attitudes toward and *interest in science* and attainment in science subjects as measured in tests (Feist, 2012).
2. *Interest in science* is seen as a specific cognitive construct that can be measured for determining its degree and strength and thus has become a cornerstone in determining science learning (Gardner, 1975; Krapp & Prenzel, 2011).
3. The concept is linked unreflexively to notions of teaching, pedagogy, and curriculum, as well as to notions of the overall goodness of science (OECD, 2007).

Constructing a wormhole to the "history of the present" of the construct Interest in Science is a way to address, in a critical way, the problematic assumptions listed: in other words, the issues of why it is important that youth are interested in science and how society and our education system make that happen would become open to new thoughts and inventions.

The second claim of this chapter is that through tracing the hybrid construct of Interest in Science in its genealogy and archaeology, one can begin to shed light on the dispositive (Dreyfus & Rabinow, 1983) of the natural sciences (from now on, Science) and its effects of power on the contemporary expressions Being and Becoming. The central argument is that the construct of Interest in Science is intersected by at least three lines of thought: one about knowing, thinking, the mind, and cognition, increasingly colonized by psychology; a second about the possibility of mathematizing and measuring thinking and learning, increasingly colonized by a numerical rationality strongly represented by psychometrics; and a third about the sense of moral directionality of pedagogy, increasingly colonized by the field of education and didactics[2] research. Through chasing the chimerical construct of Interest of Science, it is shown how it is linked to and framed within specific rationalities in its contemporary manifestation.

Finding the Chimera: On the Surface of Interest in Science

The gaze employed here brings together some of Foucault's tools and Deleuze's appropriation of them: the Archive, the Map, and the Diagram and the methodology of archaeology and genealogy (Deleuze, 1986; Dreyfus, 1983; Foucault, 1972).

The Archive is the stratum in which the examination and gaze are turned to the discursive and historic formations within the specific thinkers and their

time-space. The Archive is thus here the specific writings by Herbart, Dewey, and OECD. This could also be depicted as a kind of "depth." The Map is the stratum in which the discursive formations and the horizon of particular instances of the discursive formations are exemplified. This could also be depicted as a spread or frequency within the historical strata. The Map is the various historical curriculums, school reforms, and other educational practices linking the Archive to the horizon of instances. The Diagram is the set of relations and connections among the Archive, the Map, and the practices. A diagram is always a diagram of power relations. The Diagram is thus on the "outside" of the surface of the Archive and the Map. The Diagram is here the Prussian specific patriotic spirit of the state (Herbart), American progressionism (Dewey), and, finally, late capitalism (OECD). Deleuze (1986) elaborates these elements and their relationship, drawing on Foucault's conceptualizations:

> It is the Archaeology of Knowledge which will draw out the methodological conclusions and present the generalized theory of the two elements of stratification: the articulable and the visible, the discursive and the non-discursive formations, the forms of expression and the forms of content. *(p. 49)*

The nondiscursive and discursive formations are the elements in the three different "strata of thought" (Archive, Map, and Diagram). These two elements are entwined in the analysis of Interest in Science. The analysis is thus on the surface of thought and discourse and includes not only the concept *interest in science* but also a series of related statements and notions and other instances of linguistic forms. There is no singular unit of analysis but instead a vivisection of the surface and of the discursive formations related to Interest in Science. To clarify, the nondiscursive element is not something beyond the discursive, a negative or a materiality, but the simply stratified content of an articulated discourse. Both the discursive and the nondiscursive are linked to practices, but there is no necessary causality between them.

The examination of the statements and concepts articulated in the writings of particular thinkers (the Archive) and the evidencing of how the conditions of

The Archive	The Map	The Diagram
J.F. Herbart	Prussian school reform towards mass schooling	The Prussian spirit of patriotism and the state
J. Dewey	American school reform	American progressionism
OECD	PISA (and various contemporary curriculum in science education)	Late capitalism

FIGURE 9.1 The Archive, the Map, and the Diagram

possibility (the Map and the Diagram) shaped these statements and their subsequent concepts are the two analytical moves that constitute a gaze in a Foucauldian sense.

The analysis of the concepts, statements, and notions related to the construct Interest in Science makes it possible to point to their intersections with other discursive formations. This intersection of discursive formations is borrowed from Foucault's conceptualization of the statement and its linked concepts (Foucault, 1972). This means that concepts, statements, and notions related to Interest in Science will, here and in Foucault's terminology, be *treated* as statements in the analysis. Statements are the singular events that create the discursive formations. To do otherwise would be to miss the transversed discursive formations of the Chimera and the "thresholds" between the different parts of the construct:

> And then there are different kinds of statements, which are distinguished by certain "thresholds": a single family can pass through several different kinds, while one kind can incorporate several families. For example, science implies certain thresholds beyond, which statements attain an "epistemologization," a "scientificity" or even a "formalization." *But a science never absorbs the family or formation, which defines it.*
>
> *(Deleuze, 1986, p. 17, our emphasis)*

Deleuze's interpretation of Foucault's statements is one of the reasons Interest in Science can be seen as a chimera, a discursive formation, related to a desired expression of Being. Between the three discursive families under the gaze (the Mind, the Measurement, and the Morality), within the hybrid, the thresholds are the boundaries between the body, the tail, and the head. The specific families are not analyzed in their historical totality and genesis, which is again arbitrary, but in their form and shape within the specific historical manifestations of the Chimera. The method of using uppercase letters to signify discursive formations or families of discourses is inspired by Deleuze's nomenclature of Foucault's statements (Deleuze, 1986; Deleuze & Guattari, 1987).

The families will be termed as *rationalities*, as clusters of specific discourses, again containing statements and concepts related to the overall family or rationality (rationality of the Mind, the Measurement, and the Morality). Foucault used this term after *The Archeology of Knowledge* (1972) as a somewhat more plastic term than "discursive formations" (Dreyfus & Rabinow, 1983; Foucault, 2010). A rationality springs from the historical contingent episteme but is not a causal reenactment of it. Using the term "rationality" is also a way of stating that there is a specific causality linked to those respective families of discourses, a causality stemming again from the episteme of science.

This chapter will use research concepts, statements, and notions within theories. The rationalities of the Chimera are again very much on "the outside" and

surface of the various thinkers (and PISA test) in the chapter and are shown in their discursive and nondiscursive elements. Thus a full "in-depth" textual analysis of the entirety of the thinker's theoretical work is unnecessary to identify the various rationalities at play and, in the methodology proposed here, would only depict the Archive and not the Map and the Diagram.

The thinkers here thus represent what Deleuze and Guattari (1994) called *conceptual personae*:

> The conceptual persona is not the philosopher's representative but, rather, the reverse: the philosopher is only the envelope of his principal conceptual persona and of all the other personae who are the intercessors [intercesseurs], the real subjects of his philosophy.
>
> *(p. 64)*

This line of thought, with the thinker as an envelope, is employed in the analysis here. This envelope contains not neat systematic packages of reason but chimerical conceptual monsters.

The Greek imagery of the Chimera is used as a new image of thought in an effort to show how this structure is connected to Nietzsche's problematization of Becoming and Being and Deleuze's reading of him (Deleuze, 2006; Nietzsche, 1894).

The Chimestry produces a full metamorphosis in the sense that the earlier discursive formation (and intersecting rationalities) undergoes a shift or reconfiguration. One may see the statement and its concept as Interest in Science; in practice and form, it has changed into a new mythological beast only connected in the linguistic form. The Chimestry of the Chimera and its transformations (see Figure 9.1) is an attempt to grasp Foucault's notion of power and the Diagram in a clear analogy and metaphor, which depicts rather than describes the transformations taking place (Deleuze, 1986; Foucault, 1970, 1972). Power is the exercise of the Chimera with regard to its specific rationalities and disciplines within the construct. It is the very practical strategy of the institutions, the realm of the visible, and how they enact the statements and their intersected family. Power is also the transformations, the involutions of the institutions, and how logic within the articulable is transferred to the visible. The mechanisms between the transformations, the Chimestry, are the ways in which power is exercised. Chimestry is the diagrammatic transformations of the Chimera qua the power relations. A shift in the Diagram shifts the Chimera and its intersecting discursive formations. Thus without stating specifically that power is at stake in the various transformations addressed in the chapter, power is very much the dynamo and engine behind the changes of the Chimera, and without that notion in mind, one will miss its crucial role behind the "necessary" shifts in the rationalities of the Chimera.

The PISA 2006 Interest Survey: A Reenactment of the Chimera

The PISA 2006 Survey was the first study to include a comprehensive international assessment of *interest in science* (OECD, 2007). The survey was a culmination of research showing "that an early interest in science is a predictor for late science learning and/or career in a science or technology field" (p. 122). In the beginning of the 21st century, there was an explicit political and economical aim and desire to secure more interest, learning, and engagement with science, thus producing more pupils Being-Scientific. The new regime of PISA has effected significant changes in the national and international configuration of science education (Dolin & Krogh, 2010; Grek, 2009; Osborne & Dillon, 2008). The reenactment of the Chimera is one of the catalysts of that change.

The PISA 2006 findings were not remarkable. Not much had changed since the PISA 2003 Survey, and the findings regarding *interest in science* seemed quite sociologically and statistically "typical": *Interest in science* has some correlation with gender and with social and economic background (Egelund, 2007, 2008). To examine the reasons for this surprising lack of new findings, one must look at the questions and the frame of the surveys. In other words, an analysis of the Chimera and its discursive formation is needed.

> Students' support for scientific enquiry and students' interest in learning science topics were directly assessed in the test, using embedded questions that targeted personal, social and global contexts. In the case of students' interest in learning science topics, students were able to report one of the following responses: "high interest," "medium interest," "low interest" or "no interest." Students reporting high interest or medium interest were considered to report an interest in learning science topics. For attitudinal questions measuring students' support for scientific enquiry, students were asked to express their level of agreement using one of the following responses: "strongly agree," "agree," "disagree" or "strongly disagree." Students reporting that they strongly agreed or agreed were considered to support scientific enquiry.
>
> *(OECD, 2007, p. 123)*

The quote evidences the clearly assumed causal linkage among attitudes, scales, and *interest in science*. It is a manifestation of the discursive formation of Interest in Science and the rationalities traversing it. It is a contemporary "fact" that youth's attitudes regarding science are measurable attributes within the students (Gardner, 1975). The attributes can be retrieved by questions and become an object of study to put on a scale. The transformation of qualitative traits into quantitatively reified facts is part of the modern rationality, where "numbers have come to epitomize the modern fact, because they have come to seem preinterpretive or even somehow noninterpretive at the same time that they have become the bedrock of

systematic knowledge" (Poovey, 1998, p. xii). The mathematical measurement of the Chimera is labeled the Measurement, as a name for the family of discourses that all have the specific aim to measure, quantify, and enact statistical models and provide a numerical language of intelligibility to talk and think about education (Popkewitz, 2012).

Another important element in the framing of the PISA 2006 Survey is the assessment's goal in bonding the Measurement with the self, through the use of concepts such as the student's self-concept and self-efficacy regarding thinking and using Science (OECD, 2007, pp. 135–138). This bonding enacts a causality that produces questions in the survey to retrieve students' "sense of personal responsibility for maintaining a sustainable environment," "awareness of the environmental consequences of individual actions," and "willingness to take action to maintain natural resources" (OECD, 2007, p. 123). This trait of the Chimera, labeled the Morality, entails a family of discourses closely related to the normative, regulatory effects of pedagogy as a technology of disciplination and governmentality. In this enactment of the Chimera, there is an implied relationship between measureable psychological self-conceptualizations and moral self-regulation. This moral is expressed in, for example, Science's role in generating good conditions in society, larger issues regarding Science and the environment, and basic moral issues regarding ecological behavior.

The last trait is the visible head of the Chimera, the controlling discourse. Interest in Science is connected to enjoyment, motivation, and learning and various other concepts, which are given an intrinsic psychological meaning (OECD, 2007, pp. 139–150). The psychological trait of the Chimera is labeled the Mind. This family of discourses or rationality is of a cognitive and inner nature, an ontology, which states that *interest in science* is a domain-specific cognitive construct, a trait of personality, or even a psychological attribute from which learning emerges (Krapp, 1999). In this enactment of the Chimera, it is possible to measure the combined psychological construct "interest," through indicators of attitude in the survey.

The construct of Interest in Science in the PISA06 Survey, the contemporary chimera, is thus intersected by three different rationalities. The head of the

The Parts of the Chimera	The Rationalities	The Manifestations and Links between the Rationalities
The Head	The Mind	*Linked to Measurement and Morality.* A specific cognitive domain.
The Body	The Measurement	*Linked to Mind and Morality.* Psychometrics and statistical modelling.
The Tail	The Morality	*Linked to Mind and Measurement.* Questions within the survey connecting science to society and a holistic awareness of science's role in society.

FIGURE 9.2 The Chimera of PISA

contemporary chimera is the Mind, the proud regal lion's head of neuropsychological causality; it is dominating and controlling the body, which is the Measurement—the workings of psychometrics supporting the *logos* of the head. Finally the tail, the proverbial hidden trait, is the Morality, the steering intrinsic morality of the goodness of science for the betterment of a sustainable world, where citizens use science to do good, even to the environment. *All components are perfectly linked and entwined;* the thresholds between the rationalities have become invisible.

Herbart's Mathematical Psychology: The Measurement in the Soul

Krapp and Prenzel (2011) take Johann Friedrich Herbart's theory of education and mathematical psychology as the starting point—a milestone—for the concept of *interest in science*, since it was he who

> for the first time developed a general theory of education in which interest played a central role. He emphasized that interest must not only be regarded as a desirable motivational condition of learning but also as an important goal or outcome of education. *(p. 29)*

Johann Friedrich Herbart (1776–1841) provided a model of the mind that uses mathematical modeling akin to Sir Isaac Newton's model of the solar system. Herbart had discovered a way to expand the notion of Science and its laws and regularities into the science of psychology, which at that time was not regarded as one of the serious sciences and was still under the sway of religion and notions of the soul (Foucault, 1970).

Many thinkers were attempting, in the late 18th and the 19th centuries, to expand mathematics into the science of man (Leary, 1980). At the time of Herbart, psychology was still a dominion of the soul (Herbart, 1890). As an apprentice of Kant, he intended to expand Kant's notion of predicting physical events both in the body and in the brain to actual mental events, which went beyond Kant's explicit denial of a mathematical psychology (Kant, 2004; Leary, 1980).

Herbart's key notion of *Vorstellung*—which may roughly be translated to a sense, presentation, or idea—could be measured and predicted with mathematical accuracy (Herbart, 1890). A Vorstellung is for the mind as the atom is for the physical world: the consciousness is composed of combinations of these *Vorstellungen* behaving according to Newtonian mechanical laws (Herbart, 1891). The mental unit of Vorstellung entails thoughts, emotions, visual images, and "inner speech/voice." It is defined by a measurable strength in the consciousness reflecting the clarity of the Vorstellung (Boudewijnse et al., 1999; Herbart, 1890). Herbart's concept of Vorstellung is inspired by his education in music and the concept of *tonelehre.* From music he got the notion of strength and how Vorstellungen

could cancel each other out. It is also the concept of *tonelehre* that allows him to go beyond Newtonian concepts regarding opposing Vorstellungen in the mind (Boudewijnse et al., 1999; Herbart, 1890). In his mechanical and abstract explanation of the behavior of Vorstellungen, he provides an explanation of how one Vorstellung helps another into existence or is fused by it. With this characterization, he argues that sequential learning is attained through *repetition* (Boudewijnse et al., 1999; Herbart, 1890). Herbart's concept of interest arises from the cited conceptualization of Vorstellung:

> Interest, which in common with desire, will and the aesthetic judgment, stands opposed to indifference, is distinguished from those three, in that it neither controls nor disposes of its object, but depends upon it. It is true that we are inwardly active because we are interested, but externally we are passive till interest passes into desire or volition.
>
> *(Herbart, 1896b, p. 129)*

The intrinsic inner nature of interest is thus revealed, and Herbart stresses the transformation from the inner Vorstellung of interest to external forms in desire and volition:

> Interest only rises above mere perception in that what it perceives possesses the mind by preference, makes itself felt among the remaining perceptions by virtue of certain causality. From the preceding is immediately deduced what follows.
>
> *(Herbart, 1896b, pp. 129–130)*

Interest brings a chain of causality represented in other activities or actions: (1) observation; (2) expectation; (3) demand; and (4) action.

Herbart's mathematical study of the mind in his following writings goes beyond a desire to predict and measure the mind and enters the practice of education and pedagogy. He follows other related thinkers from the 18th century by fusing the respective sciences with Kant's Dictum—"I assert, however, that in any special doctrine of nature there can be only as much *proper* science as there is *mathematics* therein" (Kant, 2004, p. 6)—and the mathematics of Newton/Leibniz (Leary, 1980). He introduces the concept of *pedagogical tact* (Pädagogischer Takt), which is a solution to unite the problematic duality of educational theory and educational practice (Herbart, 1890). The duality is due to the problem of good and bad practice, and good practice is dependent on a scientific approach to pedagogy and educational theory.

In this there is a quite clear demarcation line posited by Herbart: an educational science may never follow the asserted causality of the natural sciences; hence the need for a clear distinction between educational theory and practice. To elaborate, educational theory gives the choice of action, but pedagogical tact makes the pupil select "the right choice." His moral and ethical thinking becomes evident through

the concept of *aesthetic necessity*, which is the judgment of a specific situation—still a judgment of taste in Kantian terms and subjected to the rules of such, but one that the educator can support and improve upon (Kenklies, 2012). The improvement of the educators' and pupils' perception of the world is the cornerstone of Herbart's mathematical concept of Vorstellung and how it evolves (Boudewijnse et al., 1999; Herbart, 1890; Kenklies, 2012; Leary, 1980). The notion of repetition and attentiveness is therefore the link between the mathematic-psychology of Herbart and his educational and pedagogical theory.

Embedded in Herbart's project of uniting mathematics, psychology, and educational/pedagogical theory, there is also the grand failure of the enterprise: He did not manage to show how the micro level of his mathematical psychology was visible at the macro level of schooling and education (Boudewijnse et al., 1999; Herbart, 1896b). The Dark Side of Pedagogy (Herbart, 1896a) was attributed to general problems regarding education, especially from his followers in both Europe and America (Dunkel, 1970). Herbart saw his mathematical psychology and theory of attention in the mind as being in direct conflict with the temporal and unsystematic nature of pedagogy and education. In other words, demands from elsewhere disturbed and "darkened" education and pedagogy and the pure instruction according to Herbart's principles.

Herbart's solution was to emphasize repetition as the method to achieve learning, repeating and reinforcing the pupil's previous knowledge, interest, and experience (Erfahrung), and abstaining from artificial rewards to the pupil. The Dark Side of Pedagogy transformed into a specific form of disciplination through repetition far from the pure mathematical psychology originally intended by Herbart's writings.

The Chimera of Herbart's Interest in Science is composed of mathematics, psychology, and educational/pedagogical theory. This trinity of the Measurement, the Mind—or the Soul in early psychology—and the Morality of pedagogy are the head, body, and tail of his Chimera.

In this historical episteme, the proverbial head of the construct of Interest in Science, openly and proudly displayed, is thus the regal mathematical lion of causality and encompasses the totality of the soul. The goat's body and main functioning of the concept of Interest in Science is a notion of psychology founded not in biology and physiology but in Vorstellung and abstract notions of repetition, fusion, and attention—still in the nomenclature of the Mind/Soul.[3] The tail of the Chimera, the hidden and steering manifestation of the construct, is morality emphasized by educational and pedagogical theory. The concept of *interest in science* is, in the 19th century, not explained as a "thing in itself" but as a measurable, internal structure and unit that should be developed according to a judgment of taste. This Chimera remains, though, a creature of mythos in the various discursive formations of the century. Herbart's Dark Side of Pedagogy evidences the failure of linkage between the various parts of the beast. The relation among measurement, soul, and morality is never fully realized in Herbart's discourse.

The parts of the Chimera	The Rationalities	The Manifestations and link between the rationalities
The Head	The Measurement	*Linked to The Mind/Soul.* The mathematical model of Herbart.
The Body	The Mind/Soul	*Linked to The Measurement.* The notion and concept of Vorstellung. The unit in The Mind.
The Tail	The Morality	*Unlinked.* The pedagogy of Herbart. The disciplination of the child. Dark Side of Pedagogy.

FIGURE 9.3 The Chimera of Herbart

Dewey's Interest versus Effort: The Fragmentation of the Concept

Krapp and Prenzel state that Dewey adopted Herbart's ideas regarding *interest in science* (Krapp & Prenzel, 2011). Specifically, the text *Interest and Effort in Education* (Dewey, 1913) is central in the analysis of how the construct Interest in Science was composed in 1913 in the United States and shows the early form of Dewey's Chimera. Henry Suzzalo, president of the University of Washington at Seattle, in his editorial comment on this text spells out the reason for Dewey's importance—the failure of the spirit of the Prussian School Regime through repetition and physical disciplination:

> To this end we have established a compulsory school attendance age, forbidden child labor, and provided administrative machinery for executing these legal guarantees of the rights of children. Yet, a guarantee of school attendance will never of itself fulfill the purposes of state education. The parent and the attendance officer, reinforced by the police power of the state, can guarantee only one thing—the physical presence of the child at school. It is left to the teacher to insure his mental attendance by a sound appeal to his active interests.
>
> *(Dewey, 1913, p. viii)*

There is a dichotomy between physical attendance and mental attendance of school, and the editor appoints Dewey's thinking as the solution to the problem. Dewey's discourse in *Interest Effort in Education* (1913) proposes a reform of how to think and do education in line with his new philosophy. He constructs a theoretical a binary between interest and effort and proposes a stance and practice between these two poles. Both the contemporary theories of effort and interest are wrong, and both are "intellectually and morally harmful" (Dewey, 1913, p. 97). Dewey proposes that interest be placed at the center of a theory of education. A twofold or binary position is then enunciated:

> The positive contributions of the idea of interest to pedagogic theory are twofold. In the first place, it protects us from a merely *internal* conception of mind; and in the second place from a merely *external* conception of subject matter.
>
> *(Dewey, 1913, pp. 91–92; Dewey's emphasis)*

Dewey tries to escape the binary of interest and effort by internalizing subject matter and externalizing the mind. In the terminology of the Chimera, he creates a clear connection between the Mind and the Morality, which in this historical configuration becomes subject matter leading to democracy. He proposes that interest cannot be understood without this binary.

The Mind in Dewey's terms is very much a psychological phenomenon, with a basis in stimulus and motor response. He uses the physiological discourse on the brain and perception:

> The teachings of Pestalozzi and of the sense-training and object-lesson schools in pedagogy were the first important influence in challenging the supremacy of a purely formal, because inner and abstract, conception of self-activity. But, unfortunately, the psychology of the times was still associated with a false physiology and a false philosophy of the relations of the mind and the body.
>
> *(Dewey, 1913, p. 70)*

In this quote he emphasizes how his conception of Mind has moved beyond the accounts of the 19th century, indirectly implicating Herbart, and into a new line of thought. What is of interest here with regard to the modern contemporary form of the Chimera is the direct link between the mind and the body in Dewey's terminology. Dewey has also previously stated the clear connection between moral (or ethical) behavior and psychology:

> But when once the values come to consciousness, when once Socrates insists upon the organic relation of a reflective life and morality, then the means, the machinery by which ethical ideals are projected and manifested, comes to consciousness also. *Psychology must be born as soon as morality becomes reflective.* Moreover, psychology, as an account of the mechanism of workings of personality, is the only alternative to an arbitrary and class view of society, to an aristocratic view in the sense of restricting the realization of the full worth of life to a section of society.
>
> *(Dewey, 1900, p. 122; authors emphasis)*

In Dewey's discourse, there is a clear link between the Mind and the Morality, between psychology and pedagogy, ultimately leading to democracy. Dewey—unlike Herbart—sees them as mutual requirements for achieving a just society. But

what of the Measurement, so evident in Herbart's Chimera, vanished from the rationalities of Dewey? In the discourse of Dewey in *Interest and Effort* (Dewey, 1913), measurement of the activity born by true educative interest is in fact immeasurable:

> The kinds of activity remaining as true educative interests vary indefinitely with age, with individual native endowments, with prior experience, with social opportunities. It is out of the question to try to catalogue them.
>
> *(Dewey, 1913, p. 67)*

In Dewey's later writings, however, he rescinds that limitation, especially in his text on building an education based on the concept of experience and of a specific organization of subject matter:

> I am aware that the emphasis that I have placed upon scientific method may be misleading, for it may result only in calling up the special technique of laboratory research as that is conducted by specialists. But the meaning of the emphasis placed upon scientific method has little to do with specialized techniques. It means that scientific method is the only authentic means at our command for getting at the significance of our everyday experiences of the world in which we live. *It means scientific method provides a working pattern of the way in which and the conditions under which experiences are used to lead ever onward and outward.*
>
> *(Dewey, 1938, pp. 87–88)*

In the terminology of this chapter, Dewey's specific form of the Measurement is thus specifically the scientific method, especially concerning the causality regarding a proper organization of subject matter. This feature is, though, the least explored concept of Dewey's, because of the immeasurableness of his conceptualizations of the Mind and the Morality. The Measurement in Dewey's Chimera is only indirectly linked to the other two. What is interesting for the conceptualization and construction of Interest in Science is the introduction of the *scientific method* into the discourse on interest. No longer satisfied with education being merely linked to pedagogy, what took a warped and ultimately failed form in Herbart's writings is completed in Dewey's. Education is now regarded among the sciences as a specific application of psychology and ethical thought, and the link is ultimately in Dewey's terminology between education and democracy (Dewey, 1916).

To summarize, Dewey's Chimera consists of the Morality, which in his enactment is the proud head of democracy and pedagogy, the true aim of education, and the Mind, which is the body and functions perfectly linked to the Morality through the conceptualization of experience, founded in a psychological and physiological understanding of the Mind; finally, the tail is a somewhat unaddressed and hidden feature of Dewey's conceptualization, the Measurement.

The Parts of the Chimera	The Rationalities	The Manifestations and Links between the Rationalities
The Head	The Morality	*Linked to The Mind through concept of experience.* The pedagogical writings of Dewey. Education and Democracy.
The Body	The Mind	*Linked to The Morality through the intrinsic concept of experience.* Thought and thinking. His biological and physiological notion of The Mind.
The Tail	The Measurement	*Unlinked in the early writings later connected to both The Morality and The Mind through a concept of scientific method.* Experience and Education. Notions on an educational science.

FIGURE 9.4 The Chimera of Dewey

Dewey's "tail" was first truly hidden in the "body of the Chimera"—only the inheritance from physiology contained "measures"; but later the tail becomes more and more visible, especially in his later writing, he is forced to address the Measurement of education and experience. One never sees a perfect linked trinity in Dewey's Chimera, though one can glimpse the ascendancy of the Measurement in Dewey's later writings.

The Contemporary Chimera Revisited

The Chimera of today, as enacted in the PISA survey, is a perfect hybrid. The links, thresholds, and rationalities are faultlessly connected. We have a conceptualization of *interest in science* as something that is within the individual pupil and citizen (the Mind as the head). It is scalable and can be used to measure the effects of science education (the Measurement as the body) and, finally, Interest in Science is a good thing, connected to democracy, sustainable development, and a holistic awareness of natural role in society (the Morality as the connected tail). In short, we have tamed the Becoming-Chimera and resolved the intrinsic conflicts within the earlier transformations.

The tool of taming of the Chimera is closely related to an intricate dance between what Thomas Popkewitz (2004) calls Alchemy and the Chimestry proposed in this chapter. Alchemy is, in other words, the link and process of transformation between the rationality of the Mind and curriculum (here placed in the strata of the Map). The engine that drives this particular alchemy is the Chimestry—the outside of thought. The inscription on the pupil, in respect to Interest in Science, thus becomes something more than just the specific rationality of the Mind—the complete amalgam of the tamed contemporary Chimera.

Psychology, here called the rationality of the Mind, is enacted in the progress of scientification of mind (specifically interest) in the curriculum, and this taming/scientification of the Mind is critically related to the taming of the Chimera. To

achieve a taming of the Mind, instances of Chimestry invoked the Measurement, and to reinforce that particular bondage, the Morality became the lever that pivoted the disparate parts into a perfect fit.

Something interesting appears when one compares the two earlier manifestations of the Chimera with the contemporary one. Herbart's Chimera (see figure 9.3) had the Measurement as the proud head of causality. This was coupled with a notion of the Mind or the Soul, founded not in physiology but in metaphysics, as the body. Last, he had the Dark Side of Pedagogy, the educational science, which can never be a true science and is thus a hidden necessity and doomed to a pragmatic stance, the tail of the Morality.

Dewey's Chimera (see figure 9.4) had undergone a Chimestry from Herbart's 19th-century construct. The Chimera of Dewey had the Morality (or pedagogy) as the head of the construct of interest, ultimately leading to democracy. The body consisted of the Mind, a psychology founded in physiology, and "modern" psychological theory, though with Dewey's notion of experience, bridging the Morality and the Mind. The tail was the Measurement, first in his writings deemed impossible, but later surfaced as the specific scientific method. Education as a specific science is the discursive result of Dewey's conceptualizations.

The common feature of the two earlier chimeras was their *brokenness*, or their various failed links, and the incoherent nature of the two Chimeras. Even though Dewey encapsulated a watered-down form of the Measurement, it was never in the form of the causality of attitude measurement or statistics; he did not dare to put the Mind into the form of numbers as Herbart tried to do.

The critical question thus arises: Is a tamed contemporary perfect Chimera, a stunted Chimestry, productive for the conceptualization of *interest in science* and ultimately Being-Scientist and in whose interests is it that the Chimera is so perfectly linked?

In other words, what process of Chimestry led to the taming of the Chimera and which "will" willed it?

Researchers in the social sciences have pointed out problems in the increasing trend of measurement and comparativeness in educational research (Grek, 2009; Grek, Lawn, Lingard, & Varjo, 2009; Lawn & Grek, 2012), and the claim of this chapter is that the Chimera "resolved" acts as a dogmatic image of thought to obscure the effects of the scientification of education and ultimately hinder Becoming-Chimera. The contemporary Chimera has thus become truly monstrous—not in the form of a chaotic eternal return, pure chance, but as a cybernetic Chimera of late capitalism caged in fixed structures of science education.

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Notes

1. The concept/notion will here be called *interest in science*. The discursive formation (the construct of the Chimera) will be termed Interest in Science.
2. Being-Scientist is here assembled as a construct of thought and discourse, a discursive formation, not actual Being in the Deleuzian terminology. Being-Scientist, and the related becoming-Chimera, is though related to Being in the Deleuzian sense as a mode of thought and an *expression* of the univocity of Being (Deleuze, 1988, 1990).
3. The term "didactics" refers to the European tradition of systematic thinking about teaching and learning (Hopmann, 2007).
4. In this historical epoch, a duality is instated in both the statements and the concepts of Herbart. He uses the German word for soul as the anchor of a psychology but avoids religion in that regard; it is only brought to the field when issues of disciplination and instruction are at hand (Herbart, 1890). An extensive analysis of the duality of the Mind/the Soul in this epoch has previously been undertaken by Foucault (1970).

References

Boudewijnse, G.-J. A., Murray, D. J., & Bandomir, C. A. (1999). Herbart's mathematical psychology, *History of Psychology, 2*(3), 163–193. doi 10.1037/1093–4510.2.3.163

Daston, L., & Galison, P. (2007). *Objectivity.* New York: Zone Books.

Deleuze, G. (1986). *Foucault* (S. Hand, trans., 2006 ed.). London: Athlone Press.

Deleuze, G. (1988). *Spinoza: Practical philosophy.* San Francisco: City Lights Books.

Deleuze, G. (1990). *Expressionism in philosophy: Spinoza.* New York, Zone Books.

Deleuze, G. (1994). *Difference and repetition.* London, Continuum Group.

Deleuze, G. (2006). *Nietzsche and philosophy.* London & New York: Continuum International Publishing Group.

Deleuze, G., & Guattari, F. (1987). *A thousand plateaus: Capitalism and schizophrenia*. Minneapolis: University of Minnesota Press.

Deleuze, G., & Guattari, F. (1994). *What is philosophy?* New York: Columbia University Press.

Dewey, J. (1900). Psychology and social practice. *Psychological Review, 7*(2), 105.

Dewey, J. (1913). *Interest and effort in education.* London: Forgotten Books.

Dewey, J. (1916). *Democracy and education.* New York: Dover Publications.

Dewey, J. (1938). *Experience and education.* New York: Touchstone.

Dolin, J., & Krogh, L. (2010). The relevance and consequences of PISA science in a Danish context. *International Journal of Science and Mathematics Education, 8*(3), 565–592. doi: 10.1007/s10763-;010-;9207-;6

Dreyfus, H. L., & Rabinow, P. (1983). *Michel Foucault: Beyond structuralism and hermeneutics.* Chicago: University of Chicago Press.

Dunkel, H. B. (1969a). Herbartianism comes to America: Part I. *History of Education Quarterly, 9*(2), 202–233.

Dunkel, H. B. (1969b). Herbartianism comes to America: Part II. *History of Education Quarterly, 9*(3), 376–390.

Dunkel, H. B. (1970). *Herbart and Herbartianism: An educational ghost story.* Chicago: University of Chicago Press.

Egelund, N. (Ed.). (2007). *PISA 2006—Danske unge i en international sammenligning.* København: Danmark Pædagogiske Universitetsforlag.

Egelund, N. (2008). *PISA og ungdomsuddannelserne 2006—kompetencer hos 16-1/2-årige elever i fire typer af danske ungdomsuddannelser foråret 2006.* København: Danmark Pædagogiske Universitetsforlag.

Feist, G. J. (2012). Predicting interest in and attitudes toward science from personality and need for cognition. *Personality and Individual Differences, 52,* 771–775.

Foucault, M. (1970). *The order of things: An archaeology of the human sciences* (2nd ed.). New York: Routledge.

Foucault, M. (1972). *Archaeology of knowledge* (A. M. S. Smith, trans., 1st English ed.). London: Routledge.

Foucault, M. (2010). *The birth of biopolitics: Lectures at the College de France, 1978–1979* (G. Burcell, trans.). New York: Palgrave Macmillan.

Gardner, P. L. (1975). Attitude measurement: A critique of some recent research. *Education Research, 7,* 101–109.

Grek, S. (2009). Governing by numbers: The PISA "effect" in Europe. *Journal of Education Policy, 24*(1), 23–37.

Grek, S., Lawn, M., Lingard, B., & Varjo, J. (2009). North by northwest: Quality assurance and evaluation processes in European education. *Journal of Education Policy, 24*(2), 121–133.

Herbart, J. F. (1890). Psyuchologie als Wissenschaft [Psychology as science]. In K. F. Kehrbach, O. (ed.), *Jon. Fr. Herbart's sämtliche Werke in chronologischer Reihenfolge* (Vol. 5, pp. 177–434). Lagensalza, Prussia: Hermann Beyer und Söhne.

Herbart, J. F. (1891). *A textbook in psychology: An attempt to found the science of psychology, on experience, metaphysics, and mathematics* (M. K. Smith, trans.). London: Forgotten Books.

Herbart, J. F. (1896a). *Herbart's ABC of sense-perception, and minor pedagogical works* (Vol. 36). New York: D. Appleton.

Herbart, J. F. (1896b). *The science of education, its general principles deduced, from its aim and the aesthetic revelation of the world.* London: Forgotten Books.

Hopmann, S. (2007). Restrained teaching: The common core of Didaktik. *European Educational Research Journal, 6*(2), 109–124.

Kant, I. (2004). *Kant: Metaphysical foundations of natural science.* Cambridge: Cambridge University Press.

Kenklies, K. (2012). Educational theory as topological rhetoric: The concepts of pedagogy of Johann Friedrich Herbert and Friedrich Schleiermacher. *Studies in Philosophy & Education, 31*(3), 8. doi: 10.1007/s11217-;012-;9287-;6

Krapp, A. (1999). Interest, motivation, and learning: An educational-psychological perspective. *International Journal of Science Education, 14*(1), 23–40. doi: 10.1007/BF03173109

Krapp, A., & Prenzel, M. (2011). Research on interest in science: Theories, methods, and findings. *International Journal of Science Education, 33*(1), 23.

Lawn, M., & Grek, S. (2012). *Europeanizing education: Governing a new policy space.* Oxford: Symposium Books.

Leary, D. E. (1980). The historical foundation of Herbart's mathematization of psychology. *Journal of the History of the Behavioral Sciences, 16,* 150–163.

Nietzsche, F. W. (1894). *Die Geburt der Tragödie aus dem Geiste der Musik.* Leipzig, Germany: C. G. Naumann.

OECD. (2004). *Messages from PISA 2000.* Paris: OECD.

OECD. (2006). *Evolution of student interest in science and technology studies. Policy report.* Paris: OECD.

OECD. (2007). *PISA 2006 science competencies for tomorrow's world* (*Vol. 1—Analysis*). Paris: OECD.

Osborne, J., & Dillon, J. (2008). *Science education in Europe: Critical reflections* (A report to the Nuffield Foundation). London: Nuffield Foundation.

Poovey, M. (1998). *A history of the modern fact: Problems of knowledge in the sciences of wealth and society.* Chicago: University of Chicago Press.

Popkewitz, T. S. (2004). The alchemy of the mathematics curriculum: Inscriptions and the fabrication of the child. *American Educational Research Journal, 41*(1), 3–34.

Popkewitz, T. S. (2012). Numbers in grids of intelligibility: Making sense of how educational truth is told. In H. Lauder, M. Young, H. Daniels, M. Balarin, & J. Lowe (Eds.), *Education for the knowledge economy? Critical perspectives* (pp. 169–191). Florence, KY: Routledge.

Sjøberg, S., & Schreiner, C. (2010). *The ROSE project. An overview and key findings.* Oslo, Norway: Oslo University.

[2] THE CELESTIAL REALM OF THE STRUCTURAL HEROES

Lt. James Gordon: Because he's the hero Gotham deserves, but not the one it needs right now. So we'll hunt him. Because he can take it. Because he's not our hero. He's a silent guardian. A watchful protector. A Dark Knight.

(Nolan, 2008, The Dark Knight)

Barry Allen (The Flash): What if Wells is right? What if I'm not a hero? What if I'm some guy who was struck by lightning?

Oliver Queen (The Green Arrow): I don't think that bolt of lighting struck you, Barry. I think it chose you.

Barry Allen: I'm just not sure I'm like you, Oliver. I don't know if I can be some vigilante.

Oliver Queen: You can be better because you can inspire people in a way that I never could. Watching over your city like a guardian angel, making a difference, saving people... in a flash. Take your own advice, wear a mask.

(Johns & Kreisberg, 2014, The Flash: Pilot)

"Doubt reigned in the celestial councils. Should they kill them and annihilate the race with thunderbolts, as they had done the giants, then there would be an end of the sacrifices and worship which men offered to them; but, on the other hand, the gods could not suffer their insolence to be unrestrained. At last, after a good deal of reflection, Zeus discovered a way. He said: 'Methinks I have a plan which will humble their pride and improve their manners; men shall continue to exist, but I will cut them in two and then they will be diminished in strength and increased in numbers; this will have the advantage of making them more profitable to us. They shall walk upright on two legs, and if they continue insolent and will not be quiet, I will split them again and they shall hop about on a single leg.' He spoke and cut men in two(…)After the division the two parts of man, each desiring his other half,

came together, and throwing their arms about one another,
entwined in mutual embraces, longing to grow into one,"
(Plato, 1892, pp. 1380-1381)

[2,3]´´ THE SECOND HALL OF SENSE

The Structural Hero is instantly transported to a place outside of space and time but still located in the labyrinth. He has arrived at the celestial heights, which has been named Olympia, Valhalla, Elysium et cetera. This is where the structural virtual Gods live, where heroes wander and are birthed. Every God is an expression/expressed and connected to the plane of immanence below, every God is an envelope of something infinitely more and infinitesimally less. Three gods stand together beckoning the Structural Hero to assume their guise, adopt and equip their mode of power to explore the labyrinth from whence he came.

The messenger of the Gods Hermes/Hermod is connected through an infinite amount of manifestations, an anchor to the surface, to the Flash, to Foucault, to Eminem. He resonates with lightning, the Speed-Force, the instantaneous split and jump from 0 to 1, mapping and cartographing a surface, which changes as soon as it is being trod. He moves with impossible Speed to reach the notion of God quickly before one loses sight and is dragged back to the celestial heights.

The rebel of the Gods, Prometheus/Loki is connected to the surface as well to Marx, Durkheim, Green Lantern, Bourdieu and Bob Dylan. Prometheus is filled with the gift of fire, of resistant will. His gifts allows him to replicate, manufacture and willfully resist regimes of oppression. His role is to mimick the enemy pointing out the cracks in the surface, to release the Unreason, and to ultimately be the father of monsters. Loki is the father of the Fenris Wolf, The Midgaard Serpent and Hel Queen of the death realm. Green Lantern is the fearless hero of creative will, recreating the weapons of the enemy into an arsenal of his own.

The brother to Zeus and Hades, Poseidon ruler of the seas and of the depths under the surface. The most powerful of the trio, rival only to Zeus and Hades themselves, he is the God of bodies and of everything connected both below and on the surface. Poseidon can evoke the earthquake and tsunamis, which cracks open the very surface and roll upon the surface of the seas, able to unleash the monsters, chained in the depths, and which perhaps Lovecraft was the only one to glimpse and then followingly go mad. Poseidon is the condition of possibility of the Greek City State, of the Trireme. He has a long line of transformations and manifestations from Aquaman, to Deleuze to Spinoza and Rammstein. And his fiercest enemy isn't Zeus or Reason, but the negative Void of unintensity of Hades and Hegel.

The trio sends the Structuralist Hero falling/descending rapidly into the Labyrinth now equipped with the Speed Force of the Flash, Green Lanterns ring of will and carrying Poseidon's/Aquaman's scepter/hammer to mimic Nietzsche's mjolnir to summon the depths at his command.

> This is one of structuralism's essential ideas, unifying authors as different as Levi-Strauss, Lacan, Foucault, and Althusser: *the idea of sense as an effect produced by a specific machinery, a physical, optic, sonorous effect, etc.* (And this is not the same thing as an appearance.) Well, an aphorism by Nietzsche is a sense-producing machine, in that order specific to thought. Of course, there are other orders, other machineries—for example, those which Freud discovered, and others still that are political or practical in nature. *But we must become machinists, "operators."* (Deleuze, 2004a, p. 137, my emphasis)

[3,5]´´´ A STRUCTURALIST/STRUCTURAL HERO - AN ACCOUNT OF THE RELATION BETWEEN STRUCTURALISM AND SCIENCE EDUCATION

> We must avoid thinking that the return is the form of a content that is difference; rather, from an always-nomadic and anarchic difference to the unavoidably excessive and displaced sign of recurrence, *a lightning storm was produced which will bear the name Deleuze: new thought is possible; thought is again possible*. (Foucault, 1994, p. 367, my emphasis)

[5,8]´´´ A READING OF *HOW DO WE RECOGNIZE STRUCTURALISM?* AND THE CRITERIA FOR THE INVESTIGATION OF SURFACES

One instance of Deleuze's writing clamors distinctly through the labyrinth, even more influential for this fabricturalist than Deleuze's book on Foucault, his essay *How Do We Recognize Structuralism?* (Deleuze, 2004a). This piece served as the great wormhole between thinkers, connecting the original protagonists, Foucault and Bourdieu, in a strange new alliance - within Deleuze's ontology and line of thought. In this essay Deleuze analyzes, in 1967, the great figures of structuralism Lacan, Althusser, Levi-Strauss, Foucault, recognizing what is similar to all of their approaches. Deleuze unravels the object = x, the paradoxical element common in all of them, and thus sets the tone for a specific Deleuzian kind of structuralism, through a 'buggery' of other thinkers (Smith & Somers-Hall, 2012; Stolze, 1998). His buggery is not a critique in the negative sense though, and Deleuze remains true to his affirmative credo and style of engaging other thinkers. Deleuze sets up seven criteria for structuralism, demarcates its unique approach and how it contributes to a

new understanding of structure. These seven criteria are the very frames of the exploration undertaken in this research.

> The *first criterion of structuralism, however, is the discovery and recognition of a third order, a third regime: that of the symbolic.* The refusal to confuse the symbolic with the imaginary, as much as with the real, constitutes the first dimension of structuralism. (Deleuze, 2004a, p. 171, my emphasis)

Here Deleuze poses a 'third order', beyond the Real and Imaginary. On Foucault Deleuze writes:

> Beyond the history of men, and the history of ideas, Michel Foucault discovers a deeper, subterranean ground that forms the object of what he calls the archaeology of thought. Behind real men and their real relations, behind ideologies and their imaginary relations, Louis Althusser discovers a deeper domain as object of science and of philosophy.(Deleuze, 2004a, p. 172)

This is not the usual symbolic domain as seen previously by Freud, which are of the Imaginary and the Real, but a structural substratum only recognizable by the structuralist hero:

> In Lacan's work, in the work of other structuralists as well, the symbolic as element of the structure constitutes the principle of a genesis: structure is incarnated in realities and images according to determinable series. Moreover, the structure constitutes series by incarnating itself, but is not derived from them since it is deeper, being the substratum both for the strata of the real and for the heights [dels] of imagination. (Deleuze, 2004a, p. 172)

Deleuze distinguishes sharply this structure from common notions such as essence or form and he gives it its own original nature and function:

> Structure is defined, on the contrary, by the nature of certain atomic elements which claim to account both for the formation of wholes and for the variation of their parts. *It has nothing to do with figures of the imagination, although structuralism is riddled with reflections on rhetoric, metaphor and metonymy, for these figures themselves imply structural displacements which must account for both the literal and the figurative. Nor has it has anything to do with an essence:* it is more a combinatory formula [une combinatoire] supporting formal elements which by themselves have neither form, nor signification, nor representation, nor content, nor given empirical reality, nor hypothetical functional model, nor intelligibility behind appearances. No one has

> better determined the status of the structure as identical to the "Theory" itself than Louis Althusser—and the symbolic must be understood as the production of the original and specific theoretical object.(Deleuze, 2004a, p. 173, my emphasis)

The *second criterion* of structuralism is the local or positional criteria. Here Deleuze sets out to define the specific space in structuralism:

> *It is not a matter of a location in a real spatial expanse, nor of sites in imaginary extensions, but rather of places and sites in a properly structural space, that is, a topological space.* Space is what is structural, but an unextended, pre-extensive space, pure spatium constituted bit by bit as an order of proximity, in which the notion of proximity first of all has precisely an ordinal sense and not a signification in extension.(Deleuze, 2004a, p. 174, my emphasis)

This space predefine the subject, it is what allows the subject to be recognized as subject. The space is thus not spatial in the ‘real spatial expanse’ but a relational space. This relational space is closely connected to a primacy of sense.

> As Levi-Strauss says in his discussion with Paul Ricoeur, sense is always a result, an effect: not merely an effect like a product, but an optical effect, a language effect, a positional effect. There is, profoundly, a nonsense of sense, from which sense itself results. Not that we return in this way to what was once called a philosophy of the absurd since, for such a philosophy, sense itself is lacking, essentially. For structuralism, on the other hand, there is always too much sense, an overproduction, an over-determination of sense, always produced in excess by the combination of places in the structure. (Hence the importance, in Althusser's work for example, of the concept of *over-determination.*) *Nonsense is not at all the absurd or the opposite of sense, but rather that which gives value to sense and produces it by circulating in the structure.* (Deleuze, 2004a, p. 175, my emphasis)

In this specific space there is a specific theatre or game afoot. This game is very much alike the positional and relational field Bourdieu unveiled in his work (Bourdieu, 1977, 1984, 2004). Additionally the recognition and discovery of the new space herald a new view on the subject:

> The third consequence is that structuralism is inseparable from a new materialism, a new atheism, a new anti-humanism. For if the place is primary in relation to whatever occupies it, it certainly will not do to replace God with man in order to change the structure. (Deleuze, 2004a, p. 175)

The *third criterion* regarding structuralism is regarding its nature, and not essence, which Deleuze sees as differential and singular:

> Every structure presents the following two aspects: a system of differential relations according to which the symbolic elements determine themselves reciprocally, and a system of singularities corresponding to these relations and tracing the space of the structure. Every structure is a multiplicity.(Deleuze, 2004a, p. 177)

It is thus up to the Structuralist Hero to uncover these differential relations and singular points. Deleuze is quite specific this isn't a mathematical exercise in metaphors but an exploration alike the one undertaken by Althusser, Foucault and Levi-Strauss:

> In any case, the symbolic elements and their relations always determine the nature of the beings and objects which come to realize them, while the singularities form an order of positions that simultaneously determines the roles and the attitudes of these beings in so far as they occupy them. The determination of the structure is therefore completed in a theory of attitudes which explains its functioning. (Deleuze, 2004a, p. 177)

The new subject is thus seen in this light of relations and points.

> The true subject is the structure itself: the differential and the singular, the differential relations and the singular points, the reciprocal determination and the complete determination.(Deleuze, 2004a, p. 178)

The *fourth criterion* is regarding the specific unconscious nature of the structures, their virtual state of existence.

> Structures are necessarily unconscious, by virtue of the elements, relations and points that compose them. Every structure is an infrastructure, a micro-structure. In a certain way, they are not actual. What is actual is that in which the structure is incarnated or rather what the structure constitutes when it is incarnated. But in itself, it is neither actual nor fictional, neither real, nor possible.(Deleuze, 2004a, p. 178)

To specify the structures existence in his own nomenclature Deleuze calls the mode of the structures for virtuality.

> To discern the structure of a domain is to determine an entire virtuality of coexistence which pre-exists the beings, objects and works of this domain. Every structure is a multiplicity of virtual coexistence.(Deleuze, 2004a, p. 179)

Coexisting within the structural domain is thus a virtual whole ensemble, having a peculiar existence of its own.

> We must therefore distinguish between the total structure of a domain as an ensemble of virtual coexistence, and the sub-structures that correspond to diverse actualizations in the domain. Of the structure as virtuality, we must say that it is still undifferentiated (c), even though it is totally and completely differential (t). *Of structures which are embodied in a particular actual form (present or past), we must say that they are differentiated, and that for them to be actualized is precisely to be differentiated.* The structure is inseparable from this double aspect, or from this complex that one can designate under the name of differential (t) / differentiation (c), where t / c constitutes the universally determined phonemic relationship.(Deleuze, 2004a, p. 179, my emphasis)

Actualized structures are thus always differentiated.

> Structures are unconscious, necessarily overlaid by their products or effects. An economic structure never exists in a pure form, but is covered over by the juridical, political and ideological relations in which it is incarnated.(Deleuze, 2004a, p. 181)

The unconscious mentioned here by Deleuze is different from Freud's notion of the unconscious. It is a specific structural unconsciousness. Deleuze elaborates the connection between structuralism and the unconscious further in *The Logic of Sense* (Deleuze, 2004b).

> The unconscious of the structure is a differential unconscious. One might believe then that structuralism goes back to a pre-Freudian conception: doesn't Freud understand the unconscious as a mode of the conflict of forces or of the opposition of desires, whereas Leibnizian metaphysics already proposed the idea of a differential unconscious of little perceptions? *But even in Freud's writing, there is a whole problem of the origin of the unconscious, of its constitution as "language," which goes beyond the level of desire, of associated images and relations of opposition*. Conversely, the differential unconscious is not constituted by little perceptions of the real and by passages to the limit, but rather of variations of differential relations in a symbolic system as functions of distributions of singularities. (…) *The structural unconscious is at once differential, problematizing and questioning. And, as we shall see, it is finally serial*.(Deleuze, 2004a, pp. 181-182, my emphasis)

The *fifth criterion* for structuralism is the aspect of the serial. This is the very ‘life’ and movement of structure. The serial aspect is again investigated more fully in *The Logic of Sense* (Deleuze, 2004b).

> They thus organize themselves in another series capable of an autonomous development, or at least they necessarily relate the first to this other series. So it is for phonemes and morphemes; or for the economic and other social series; or for Foucault's triple series, linguistic, economic and biological, etc. The question of knowing if the first series forms a basis and in which sense, if it is signifying, the others only being signified, is a complex question the nature of which we cannot yet assess. One must state simply that every structure is serial, multi-serial, and would not function without this condition. (Deleuze, 2004a, p. 182)

This aspect is crucial in relation to structural series of science. Deleuze points out that there is ‘no general rule’ and no ordered interpretation to investigates series of structures through.

> It goes without saying that the organization of the constitutive series of a structure supposes a veritable *mise en scene* and, in each case, requires precise evaluations and interpretations. *There is no general rule at all; we touch here on the point at which structuralism implies, from one perspective, a true creation, and from another, an initiative and a discovery that is not without its risks.* The determination of a structure occurs not only through a choice of basic symbolic elements and the differential relations into which they enter, nor merely through a distribution of the singular points which correspond to them. The determination also occurs through the constitution of a second series, at least, that maintains complex relations with the first. (Deleuze, 2004a, p. 183, my emphasis)

Thus in a structural analysis one often draws upon two series. Deleuze stresses that these two series are not analogue but displaced and through this displacement one arrives at sense.

> This relative displacement of the two series is not at all secondary; it does not come to affect a term from the outside and secondarily, as if giving it an imaginary disguise. On the contrary, the displacement is properly structural or symbolic: it belongs essentially to the places in the space of the structure, and thus regulates all the imaginary disguises of beings and objects that come secondarily to occupy these places. *This is why structuralism brings so much attention to bear on metaphor and metonymy. These are not in any way figures of the imagination, but are, above all, structural factors.* They are even the two structural factors, in the sense that they express the two degrees of freedom of displacement, from one series to another and within the same series. (Deleuze, 2004a, p. 184, my emphasis)

The role of metaphors and metonymies is thus expanded and it is particularly through these we arrive at the structural factors.

The displacement with series of structure irrevocably leads us to the *sixth criterion* which again has a specific ground shaking role to play in the analysis of science structure - the aspect of the empty square, object = x or the Abstract Machine.

> *It appears that the structure envelops a wholly paradoxical object or element*. (…) *Such an object is always present in the corresponding series, it traverses them and moves with them, it never ceases to circulate in them, and from one to the other, with an extraordinary agility. One might say that it is its own metaphor, and its own metonymy*. The series in each case are constituted by symbolic terms and differential relations, but this object seems to be of another nature. In fact, it is in relation to the object that the variety of terms and the variation of differential relations are determined in each case. The two series of a structure are always divergent (by virtue of the laws of differenciation), but this singular object is the convergence point of the divergent series as such. It is "eminently" symbolic, but precisely because it is immanent to the two series at once. What else would we call it, if not Object = x, the riddle Object or the great Mobile element? (Deleuze, 2004a, p. 184, my emphasis)

This object = x is the great mover and displacer of the series of structures. It takes different shapes according to, which Structuralist Hero perceives it.

> Games need the empty square, without which nothing would move forward or function. The object = x is not distinguishable from its place, but it is characteristic of this place that it constantly displaces itself, just as it is characteristic of the empty square to jump ceaselessly. Lacan invokes the dummy-hand m bridge, and in the admirable opening pages of The Order of Things, where he describes a painting by Velasquez, Foucault invokes the place of the king, in relation to which everything is displaced and slides, God, then man, without ever filling it. No structuralism is possible without this degree zero. (Deleuze, 2004a, p. 186)

This object = x is not identifiable as such and in the end Deleuze arrives at a critical point for structuralism and the paradoxical notion, which accompanies it.

> What does it consist of, this object = x? Is it and must it remain the perpetual object of a riddle, *the perpetuum mobile*? This would be a way of recalling the objective consistency that the category of the problematic takes on at the heart of structures. And in the long run, it is

> good that the question *How do we recognize structuralism?* leads to positing something that is not recognizable or identifiable.(Deleuze, 2004a, p. 187)

Deleuze posits this caveat emptor regarding structuralism but in the same movement he lays out a line of thought to encounter structuralism in accordance with the previous works of the structuralist heroes.

> A more general consequence follows from this, concerning the different "orders."(…) *All structures are infrastructures. The structural orders—linguistic, familial, economic, sexual, etc.—are characterized by the form of their symbolic elements, the variety of their differential relations, the species of their singularities, finally and, above all, by the nature of the object = x that presides over their functioning*. However, we could only establish an order of linear causality from one structure to another by conferring on the object = x in each case the type of identity that it essentially repudiates. *Between structures, causality can only be a type of structural causality. In each structural order, certainly, the object = x is not at all something unknowable, something purely undetermined; it is perfectly determinable, including within its displacements and by the mode of displacement that characterizes it. It is simply not assignable: that is, it cannot be fixed to one place, nor identified with a genre or a species.* (Deleuze, 2004a, p. 188, my emphasis)

This has a shattering methodological consequence for all would be Structural Heroes: Ethnography and extensive structural analysis won't save you through a special privilege of Reason, linguistic analysis won't save you through reasonable accounts or lived narratives, psychoanalysis has no primary access , and will definitely not save you, to the symbolic or forms of desire. The Structural Hero, the 'divided subject' [1,1]´´, must recognize this Damocles sword of paradox hovering over any analysis of structural series and attempt a careful, sensical gaze upon it, an investigation of multiple series in the same movement. In other words evoking the Principle of the Cat. Deleuze lays out four points with which to analyze this paradoxical element of different series:

> And in each structure, the object = x must be disposed to give an account 1) of the way in which it subordinates within its order the other orders of structure, that then only intervene as dimensions of actualization; 2) of the way in which it is itself subordinated to the other orders in their own order (and no longer intervenes except in their own actualization); 3) of the way in which all the objects = x and all the orders of structure communicate with one another, each order defining a dimension of the space in which it is absolutely primary; 4) of the

> conditions in which, at a given moment in history or in a given case, a particular dimension corresponding to a particular order of the structure is not deployed for itself and remains subordinated to the actualization of another order (the Lacanian concept of "foreclosure" would again be of decisive importance here).(Deleuze, 2004a, p. 189)

The last and *seventh criterion* concerns the primacy of the symbolic filling in spaces. This means that the subject as well is dispersed within that space. Everything is being subjected to this primacy of filling, except the empty square, which precisely must remain empty to function as a disperser and displacer of the series.

> Nevertheless, if the empty square is not filled by a term, it is nevertheless accompanied by an eminently symbolic instance which follows all of its displacements, accompanied without being occupied or filled. And the two, the instance and the place, do not cease to lack each other, and to accompany each other in this manner. *The subject is precisely the agency [instance] which follows the empty place:* as Lacan says, it is less subject than subjected [assujetti]—subjected to the empty square, subjected to the phallus and to its displacements. *Its agility is peerless, or should be. Thus, the subject is essentially intersubjective.* To announce the death of God, or even the death of man is nothing. What counts is how.(Deleuze, 2004a, p. 190, my emphasis)

One thus arrives at the two ‘accidents’ of structure - the filling or the ‘emptiness’.

> Structuralism is not at all a form of thought that suppresses the subject, but one that breaks it up and distributes it systematically, that contests the identity of the subject, that dissipates it and makes it shift from place to place, an always nomad subject, made of individuations, but impersonal ones, or of singularities, but pre-individual ones.(…) Henceforth, two great accidents of the structure may be defined. Either the empty and mobile square is no longer accompanied by a nomad subject that accentuates its trajectory, and its emptiness becomes a veritable lack, a lacuna. Or just the opposite, it is filled, occupied by what accompanies it, and its mobility is lost in the effect of a sedentary or fixed plenitude.(Deleuze, 2004a, p. 190)

These accidents are of a specific immanent nature and not accidents in the usual way of the outside.

> This is why what we were earlier calling accidents does not at all happen to the structure from the outside. On the contrary, it is a matter of an "immanent" tendency, of ideal events that are part of the structure itself, and that symbolically affect its empty square or subject. We call them

> "accidents" in order better to emphasize not a contingent or exterior character, *but this very special characteristic of the event, interior to the structure in so far as the structure can never be reduced to a simple essence*.(Deleuze, 2004a, p. 191, my emphasis)

In short Deleuze notion “accidents“ is precisely connected to his notion of the Event as enunciated in *The Logic of Sense* (Deleuze, 2004b). Event and structuralism is thus connected in intrinsic ways. At last we arrive at the term Structuralist/Structural Hero, which characterizes the practice of the specific subject engaging in works and analyses regarding structures. In a way Foucault, Althusser, Levi-Strauss and Lacan are these structuralist heroes.

> The contradictions must yet be "resolved," that is, the empty place must be rid of the symbolic events that eclipse it or fill it, and be given over to the subject which must accompany it on new paths, without occupying or deserting it. *Thus, there is a structuralist hero: neither God nor man, neither personal nor universal, it is without an identity, made of non-personal individuations and pre-individual singularities. It assures the break-up [I'e'clatement] of a structure affected by excess or deficiency; it opposes its own ideal event to the ideal events that we have just described.* For a new structure not to pursue adventures that again are analogous to those of the old structure, not to cause fatal contradictions to be reborn, depends on the resistant and creative force of this hero, on its agility in following and safeguarding the displacements, on its power to cause relations to vary and to redistribute singularities, always casting another throw of the dice. *This mutation point precisely defines a praxis, or rather the very site where praxis must take hold. For structuralism is not only inseparable from the works that it creates, but also from a practice in relation to the products that it interprets. Whether this practice is therapeutic or political, it designates a point of permanent revolution, or of permanent transfer.* (Deleuze, 2004a, p. 191, my emphasis)

This obscure point is vital for the Structuralist Hero, one must become a practice beyond the subject, he/she must reside within the mutation point and work praxis from that particular instance of ‘casting another throw of the dice’. This praxis must dig itself into the very Abstract Machine, the nonsensical instance and abandon the notion of the subject in the same movement. This point for praxis was the one I attempted to arrive at in the article *Between the Cat and the Principle*, through a concrete case.

[8,13]´´´ STRUCTURALISM AND THE I EXPLAINING THE INVESTIGATION OF SCIENCE AND ITS EDUCATION

Structuralism and science education takes on a specific relation since the education of science is connected to the serious sciences (physics, chemistry, mathematics etc.) in all their splendour and horror. An investigation of structural series of science education is necessarily a simultaneous investigation of the series of Science and its Education as these are constantly displaced in relation to each other. Both Bourdieu and Foucault were very well aware of the great problematic it would be to initiate such an investigation, investigating science with science itself, and this thesis can only hope to scrape and contribute to the surface of such an investigation (Bourdieu, 2004; Foucault, 1972).

But let us examine the various criteria for structuralism and see how they manifest and actualize in the investigation undertaken, leading a trail of breadcrumbs, a clear outline of research, into the labyrinth ahead. This is thus to expose how the essay *How do we recognize Structuralism?* (Deleuze, 2004a) equipped the Structuralist Hero in his investigation.

The *first criterion* is *"the discovery and recognition of a third order, a third regime: that of the symbolic"(Deleuze, 2004a, p. 171).* It would perhaps seem strange that the symbolic third order, beyond the Real and the Imaginary, plays or perhaps still play a role in Science and its Education. As soon as a Structural Hero turns the gaze superficially toward the structures it is obvious, clear and distinct, that Science plays a great symbolic role ordering our space, our thoughts, our reasoning and understanding. Education in Science is thus seen as an education in nature and the world, it is the new idol or All-Father and everything is seen in its lieu, which is visible in the legion of organizations advocating for science and its education[3].

Structures of Science constitute all of our domains both in Extension and in Thought. Everywhere one turn Science is conflated with Reason, and Science is conflated with Understanding. It is almost as if the world and nature in itself is counting to the striated rhythm of science, or as Rammstein sing *und die Welt zählt laut bis zehn* (2001) [x] - [1,1]. There is no longer a Reason or Understanding that is not somehow scientific. The nomenclature of Science, its symbols and axiomatic, support this filling of spaces. Science education is thus in a structural sense symbolic, not the symbolism of Freud or Lacan, but a particular symbolism connected to the history and conditions of science.

[3] http://www.aaas.org/program/project2061

The *second criterion* emphasise the specific structural space *"not a matter of a location in a real spatial expanse, nor of sites in imaginary extensions, but rather of places and sites in a properly structural space, that is, a topological space."* (Deleuze, 2004a, p. 174) This space, seen in the lieu of Science and its Education, becomes the premise of a problematic of Extension, of a series of structures so vast and extended they almost seems impossible to chart. It is thus not a real spatial Extension but a virtual deterritorialisation by Science. Because where does one start? Science Education is not just located in the educational institutions, that would be the limited gaze of an educational ethnographer. Nor is it only located in the universities of proper science. Rather the space of science education resides nomadically in the continuous virtual traversal and vectoring of subjects in all strata and connected fields. One is thus gazing upon nomadic fractals, a subject that in itself is a structural space of science interacting with other fields [1,1]´´- [28657,46368]´´. Only by seeing this pure virtual extendedness of the scientific constructed subject can one glimpse the infinite relations of elements. All the problems related to mapping capital (*Mapping [Capital v.2.0]),* the model of fractals (*Welcome to school*), and the analysis of the survey and interviews of the YtY Project is as an attempt to place a tracing of structures in this above stance, of connecting endlessness in topological space through discursive and non-discursive formations. By this mapping we arrive at notions of strategies, of structural unconsciousness navigating in the structures and can make sense of the Habitus manifested, as an unconscious engagement with the structures based upon a history of such confrontations. This was enunciated in *Mapping [Capital v.2.0]* [46368,5^{2}·3001]-[1597,2585]´.

The *third criterion* is concerning the nature of the specific structures, a multiplicity. Every structure thus encountered is *"a system of differential relations according to which the symbolic elements determine themselves reciprocally, and a system of singularities corresponding to these relations and tracing the space of the structure. Every structure is a multiplicity."* (Deleuze, 2004a, p. 179). Every structure one looks upon must be recognized as a multiplicity, an unanchored thing in relation, and every being and object is positioned and determined twice: 1) By the symbolic elements in differential relations (nature of being and objects) 2) By the system of singularities forming an order of positions (roles and attitudes). This has an impact when examining discourses both through interviews, survey and observations. One cannot propose a straight linear reasoning and obvious 'sense', when everything is pre-symbolic and inserted in such an above field of relations. Only by arriving at a point of sufficient Reason can one reach an Understanding of the structures at play (Deleuze, 2006). Examining multiplicities means that the researcher must traverse a nonsensical jagged line in his/her research going beyond science education proper and into the realm of non-sense. The Structuralist Hero chooses series (Science-Structure and

Science-Image) within the interviews and discourse, follows them, and vivisects forth the object = x traversing and displacing the series.

The *fourth criterion* adresses the existence of structures both in virtuality and actuality. They are by nature a ‘Leibnizian’ structural unconscious. *“Every structure is a multiplicity of virtual coexistence”*(Deleuze, 2004a, p. 179) by this Deleuze means that every structural domain has a field of virtuality coexisting with sub-fields of actuality. When structures are actualized they differentiate in the structural domain. This mean they become covered up in other forms and practices. The scientific structures are, when actualized, manifested in a multiplicity of connecting domains for example in educational, judicial and medicinal relations. These unconscious structural elements are always in this double form in the virtual and the actual. Regarding the connections and manifestations between such fields I have tried to propose a new Image Thought of the quasi-self-similar fractal to understand this virtual and actual life of structures in the various fields or domains and how the subject is in it self such a fractal space. This was enunciated in the article *Welcome to school*.

The *fifth criterion* is connected to the seriality of structures. Structures are dispersed serially and have an autonomous life of their own. This is why an investigation of Science and its Education and the related structures precisely escapes this striated space and transverse into other series in different fields. One emphasis in this thesis has been upon the aspect, which Deleuze and Guattari later call ‘popanalysis’ (Deleuze & Guattari, 1987, p. 24), a structural analysis of contemporary phenomena across different strata or plateaus. There is both a sensical/nonsensical reason why this thesis is connected to comics, literature, art and music and various other contemporary 'popular' phenomena, and it is done exactly to follow and investigate series of structures of science. Following structural series is similarly creating new series. One doesn't explore neutrally, one always explores what is and creates new connections, connecting new series. None has done this better and more refined than Foucault and his work is the work of the first serial investigator par excellence. Umberto Eco took this type of serial investigation into fiction especially in his book *Foucault’s pendulum*, which was, from an arbitrary point of origen, exploring the structural ‘sickness until death’ of the great connecting conspiracies of everything in the history of man (Eco, 2001).

The *sixth criterion* is the paradoxical element, the object = x, which is enveloped within the structure. This criterion has been of precarious consequence for the exploration and the one criterion that has made the investigation and research ‘jump’ constantly. This object = x, belonging to neither divergent series of structure, which the Structural Hero gazes upon, is the convergence point and the similar abstract machine within the structural series.

> The whole structure is driven by this originary Third, but that also fails to coincide with its own origin. Distributing the differences through the entire structure, making the differential relations vary with its displacements, the object = x constitutes the differenciating element of difference itself. (Deleuze, 2004a, p. 186)

For Marx the object = x was value, for Lacan the Phallus, for Althusser Theory but still the object = x can never been named in such an easy way, which was precisely the point I tried to make in the article *Between the Cat and the Principle*. One cannot reduce the object = x to one concept or notion, for example value or capital. The empty square (object=x) will always slip away and take another form. It is, in other words, knowable but not assignable like the exploration I did in regarding the representation of power. The methodological search through Archives and Maps has been one way, explored in this thesis, of reaching a point of sufficient Reason, a common notion regarding the structures of science in their diverse series.

The *seventh* and final criterion is here read as the specific practice of a Structuralist Hero. To be acting, mimicking and placing oneself in the very rupture (similar a point from The Cat & The Principle) as if one is a Structuralist Hero, a meta-human innovator, wearing pallid mask and invoking a creating gaze looking upon structures, vivisecting and recombining them in new ways. The writing of this PhD has all been an attempt to evoke such a practice, of engaging in nonsense, reterritorializing other forms of thought, to expose that our very minds are resisting those movements and above all to show how structures of science has deterritorialized practically all forms of Thought and Extension leaving only the dark places left of the body, of dark Science, of comics, literature and art. Only by being dragged through a labyrinth can one reach an adequate idea of science and arrive at a new Image of Thought.

> Bruce Wayne: People need dramatic examples to shake them out of apathy and I can't do that as Bruce Wayne. As a man, I'm flesh and blood, I can be ignored, I can be destroyed; but as a symbol... as a symbol I can be incorruptible, I can be everlasting.
> Alfred Pennyworth: What symbol?
> Bruce Wayne: Something elemental, something terrifying.
>
> (Nolan, 2005, Batman Begins)

[13,21]´´ TWO MACHINES AND A WORMHOLE

> Luke: Never. I'll never turn to the Dark Side. You've failed, your highness. I am a Jedi/Machinist, like my father before me.

> The Emperor: [angry] So be it... Jedi/Machinist! (Unleashes a storm of force lightning)
>
> (Marquand, 1983, Return of the Jedi, my emphasis/change)

[21,34]´´ THE FIRST MOMENT OF NON-SENSE

The structuralist hero finds himself transported to The Chamber of the two Machines. Two great machines are posited against two walls respectively.

The first machine is a compact thing, its cogs and pulleys are measured and shows a lot of wear. The machine is rigorous, stoic and spits out products of a measurable quantity and quality. This machine is an old copy of a war-machine.

The second machine is a fluid thing, it doesn't contain mechanical intestines but instead an alien apparatus of strange non-Euclidian forms. The machine is at the same time an archive, an indexical locator, a map and GPS coordinator, and an intricate diagram of other-worldly parts.

In the middle of the room there runs a border, an electric demarcation, and in the perfect center of the circular room, inside the electrical border field, is a round table where three persons circle in an intricate dance. The first person is a rustic looking black haired man, he is gesturing to the second man around the table, a bald jester, who is smiling and picking his teeth, as if he is listening to a joke unknown to all but himself. The third, nearly invisible, immeasurably old man, looks upon the two quarrelers paternally, as if to indicate calmness, serenity and that everything is connected. The old man points to the invisible cord, running between them all, indicating their similar mode of existence as simulacra and machines. These are the creators of the two machines, the rustic, thorough machine of Pierre Bourdieu and the alien apparatus of Michel Foucault. The third man is Gilles Deleuze.

The first corridor exiting this room is composed of pure electricity, and it is as if it beckons one to enter and be transformed. The lines of electricity dance like fractals constantly zooming in and out making the lightning corridor seems impossibly big and small at the same time.

The second corridor exiting this room is a corridor filled with pictures, paintings, drawings and endless simulacra of cats. All of them are smiling menacingly, a Chesire smile inviting the Structural Hero to enter, though with a hint of the upcoming destructive moment ahead of which the cats are the only one to survive.

The third corridor exiting this room a seemingly barred one-way exit overlaps with the rooms of machines. It is as if the corridor and room connected to it is superimposed upon the two machines, one begets the other in the same movement.

[34,55]´ THE FIRST MACHINE OF SENSE – A REASONABLE SELF-ACCOUNT REGARDING THE CHOICE OF THEORETICAL PERSPECTIVES - BECOMING-MACHINIST OR WHO-MADE-WHO

> Whether I shall turn out to be the hero of my own life, or whether that station will be held by anybody else, these pages must show. To begin my life with the beginning of my life, I record that I was born (as I have been informed and believe) on a Friday, at twelve o'clock at night. It was remarked that the clock began to strike, and I began to cry, simultaneously.
>
> In consideration of the day and hour of my birth, it was declared by the nurse, and by some sage women in the neighborhood who had taken a lively interest in me several months before there was any possibility of our becoming personally acquainted, first, that I was destined to be unlucky in life; and secondly, that I was privileged to see ghosts and spirits; both these gifts inevitably attaching, as they believed, to all unlucky infants of either gender, born towards the small hours on a Friday night.(Dickens, 1983, p. 1)

How do you choose the theories that suit your research? Is it an active choice, a choice of Reason or Understanding, a choice of ideology and politics or something more inexplicable?

The account below is similar and sensical like Dickens' voice in David Copperfield and mimicked by the vampire Louis in Anne Rice's *Interview with a vampire* (Rice, 2010) – "I was born.." . My story begins similarly: "I was the son of a machinist and a receptionist, destined to become a vivisectionist and projectionist."

A theoretical choice is a choice between machines. You enter into a specific abstract theoretical machine; you put in your thoughts, your 'data' and everything assembled and the machine spits out truths, half-truths, perspectives, and a certain Reason, a certain form of Truth. The critical point is here to recognize the machine, to become a true machinist, and to enter and operate several machines in the same research instant and movement. Bourdieu called this participant objectivation (Bourdieu, 2003). Foucault's oeuvre was in itself a dance and examination of particular forms of subjectivation, including especially how knowledge and discourse shapes what can be thought and what is deemed un-Thought. Foucault's notion of the apparatus and the related concept of the dispositif are in itself concepts

exploring the mechanistic tendencies regimes of truth invoke and become (Deleuze, 2007; Foucault, 2000). Deleuze has introduced the notion of machines, in different forms, throughout all his work, and they took center stage in his first collaborative work with Guattari (Deleuze & Guattari, 1983).

In the sensical work, the articles within the labyrinth, the machines of Foucault and Bourdieu together with the simulacra, machines and perspectives of Deleuze have guided this exploration of surfaces. In other words, in different movements within the articles I have tried to gaze with Foucauldian and Bourdieuian perspectives, but of course both are contaminated with Deleuze's special movement.

Bourdieu's machine of reflexive sociology was picked up between a movement of transition. Embarking from Danmark's Pædagogiske Universitet (DPU) I had a desire to invoke this machine upon the problematics that I stumbled across in my work as a teacher in special education and which ultimately led me to the YtY-Project. Bourdieu had become a close virtual friend and in the readings I found a great adversary and cautionary voice towards Foucault, which I had encountered many years before. It seemed that Bourdieu's machine of Reason, calculated statistics, elaborate conceptualizations, and focus upon Capital, could somehow destabilize, shake and enrich a Foucauldian investigation.

Foucault's machine of archaeology and genealogy had been explored previously in exams in DPU, notably the Master's thesis and problems regarding special education and the problem of the pathological. Even before reading Foucault, Umberto Eco and Nietzsche had aligned me towards his perspective of power, construction of knowledge and the limits of Reason.

In the methodology I proposed for this PhD I wanted to embark with Bourdieu and Foucault together, in a strange French marriage, not in a great moment of synthesis and joining hands but choosing two boxers (or martial artists) and letting them spar in the same ring around the same problems. Thus in the first part of the PhD journey it seemed adamant for me to somehow elaborate and enunciate such a movement, which was NEVER a true dialectical move.

Deleuze came into the ring much later but quickly assumed the role of the referee. In other words Deleuze entered with such gusto and bravo that it changed, in a very subtle way, the encounter I had set up between Foucault and Bourdieu. Deleuze is thus a hidden hand in all the articles but only in the later writings does his role become enunciated properly. It is as if I have been working towards a grand decloaking or unveilment of his influence in my thought and research.

The machines, methodologies resulted thus in a triadic structure, an intricate dance where one chases the other on a field of immanence. If there is a central concern, an electrical current of Thought through the whole dance, it is the question of power,

Capitalism, Becomings and Being and thus connected to the very core of the problem of the YtY-Project.

Choosing a machine is similarly being equipped and armed with specific methods, whether it is compartmentalizing, miniaturizing, filleting, scalping, statistics, reductio absurdum, jabberwocky, discourse analysis and an infinite number of different tools and cogs. The tools my machines arrived with were vivisections of Archives, topographing of Maps, statistically ordering of objects, practices, attributes and attitudes, observations of practices, engaging in discourse, thinking otherwise, connecting the unconnected and so forth ad infinitum absurdum…[2584,4181]´´

[55,89]´ THE WARDROBE OF THE PALLID MASKS

> This is the thing that troubles me, for I cannot forget Carcosa where black stars hang in the heavens; where the shadows of men's thoughts lengthen in the afternoon, where the twin suns sink into the Lake of Hali; and my mind will bear forever the memory of the Pallid Mask. I pray God will curse the writer, as the writer has cursed the world with this beautiful, stupendous creation, terrible in its simplicity, irresistible in its truth--a world which now trembles before the King in Yellow.
>
> (Chambers, 1895, p. 6)

> Behind this mask there is more than just flesh. Beneath this mask there is an idea... and ideas are bulletproof.
>
> (Moore & Lloyd, 2009)

[89,144]´ INSIDE THE FIRST WARDROBE OF NONSENSE

The Structural Hero stands before an old gnarled oaken wardrobe hidden in a strange and desolate asylum located deep within the labyrinth. All kinds of masks are inscribed into the wood of the wardrobe. The wardrobe is slightly trembling, bursting with an intensity of its own. As the hero opens the wardrobe (or did the wardrobe burst open and open him?) a rotten wind escapes it and fills the nostrils of the wayward explorer. It has the sickening smell of death, destruction and change. Gazing upon the wardrobe, it dawns upon the heroine that every identity can be chosen, every face be mimicked. Flipping through the various masks, the hero stumbles upon one, hidden away farthest in the wardrobe. This one beckons him most of all. It is as if the mask resonates throughout his dissolved nature, imploring him to wear it with a horrific glee. But to his horror as he puts it on he realizes it is the face of the Other, a cut-away Pallid Mask of flesh belonging to an old Structural Villain.

> The Joker: Introduce a little anarchy. Upset the established order, and everything becomes chaos. I'm an agent of chaos. Oh, and you know the thing about chaos? It's fair! (Nolan, 2008)

[144,233]´ ESSAY - A FIGHT CLUB IN EDUCATION, TOWARDS A NEW PROJECT MAYHEM

> Unlike discipline, which is addressed to bodies, the new nondisciplinary power is applied not to man-as body but to the living man, to man-as-living-being; ultimately, if you like, to man-as-species.
>
> (Foucault, 2003, p. 242)

> You aren’t alive anywhere like you are alive at fight club. When it’s you and one other guy under that one light in the middle of all those watching. Fight club isn’t about winning or losing fights. Fight club isn’t about words. You see a guy come to fight club for the first time, and his ass is a loaf of white bread. You see this same guy here six months later, and he looks carved out of wood. This guy trusts himself to handle anything.
>
> (Palahniuk, 2006, p. 51)

> It is impossible to predict the forms of struggle and organization that the revolution now starting will adopt in the future. It would seem at present that absolutely anything could happen. However, a few things seem clear - not as to what the questions will be, but what they most certainly not be. (a) They will not be centered on solely upon quantitative aims, but will be re-examining the whole purpose of work, and consequently also of leisure and of culture too. They will reconsider the environment, daily life, family life, relations between men and women, adults and children, the perception of time, the meaning of life.
>
> (Guattari, 1984, p. 270)

Chuck Palahniuk / Tyler Durden laid down the rules of Fight Club. The Fight Club is a vision of revolutionary multiplicity, or molecular revolution. The overall problematic is the contemporary transformation of man, which Foucault addresses in the above and subsequently gives the name of bio-power (Foucault, 2003). This essay and the stance of Fight Club should be seen as resistance towards that power. Palahniuk's novel Fight Club had 8 rules laid down and the aim is here to transfer these into a stance for educational researchers to address and ultimately resist the notion of bio-power. The resistance is an attempt to invoke a new Image of Thought within Education. Particularly opposing the violent training and reductionism utilized towards Thought and its connected forms. Resisting Bio-Power is resisting Mind/Thought Power.

Rules of Fight Club(Palahniuk, 2006, my formatting):

- The first rule of Fight Club is: You do not talk about Fight Club.
- The second rule of Fight Club is: YOU do NOT talk ABOUT Fight Club.
- The third rule of Fight Club: If someone yells stop, goes limp, taps out - the fight is over.
- The fourth rule: Only two guys to a fight.
- The fifth rule: One fight at a time.
- The sixth rule: No shirt, no shoes.
- The seventh rule: Fights will go on as long as they have to.
- The eight rule: If this is your first night at Fight Club, you HAVE to fight.

The Fight Club in Education (FiClE) is not an ideology but precisely an attempt to show that ideology is an illusion, a fata morgana. The aim here is not to reproduce yet another orthodox marxist/Communist stance, as this is would be exchanging one repressive power for another. It is a utopian rallying cry clamoring through all bodies that bleed, sweat and cry under the yoke of the delirium of capitalism. To show that 'the essence of man' lies in what he can do, and ultimately on ontology.

> We say: there is no ideology, it is an illusion. That's why it suits orthodox Marxism and the Communist Party so well. Marxism has put so much emphasis on the theme of ideology to better conceal what was happening in the USSR: a new organization of repressive power. There is no ideology, there are only organizations of power once it is admitted that the organization of power is the unity of desire and the economic infrastructure. (Guattari, 2008, p. 38)

Pierre Bourdieu took part in a famous series of documentary in 1998-2001, where he stated that " la sociologie is une sport de combat "[4] or translated as sociology is a martial art. Bourdieu stated that, *"You use it for self-defense without having the right to use it for unfair attacks"*. This summarizes the spirit of this paper: to introduce a specific form of "Fight Club", FiClE, a notion of martial arts introduced to educational research as a necessary stance for the researcher. This necessity isn't the usual ethical stance or a moralist posturing, the necessity comes out of the implicit connection between the body (understood as real sweat and work), blood, the project of Education, and the pupils within. Project Education is here seen as under siege by forces of deterritorilization, exercising a specific bio-power in relation to education, thus invoking a necessary stance of antagonism in all instances of related research. Before the rules can be appropriated to education is though necessary to refine the notion of martial art. It is thus necessary to transform the current Project Education into Project Education-Mayhem unleashing an intensive movement upon Learning, Knowing, Being and Becoming. In other words you have to become *friends with the monster* like Eminem raps (Eminem, 2013c) [1]´ – [1,1] ´´´ – [3] – [3,5] ´´´´ – [4181,6765]´´

In general it is prudent to introduce a dichotomy between 'soft styles' and 'hard styles' of martial arts. The soft styles include specific forms of martial art such as judo, aikido, jiu-jitsu. These forms revolve around activities of throwing, locking, disabling and other related defensive maneuvers to convince the opponent or partner that violence isn't a productive path to pursue. The hard styles include specific forms such as karate, kung-fu, boxing and similar offensive martial arts. These forms are closely related to resisting oppression, especially karate was a way of rearming the peasants in their struggle against the samurai lords. In hard styles,

[4]https://www.youtube.com/watch?v=_9PCp9oKPRw&list=PLEWZrOTnVz78jTIIxayJQP9yfRHeClAh-

the philosophy is to turn your body into a weapon, to become a war machine, and to be able to disable opponents of superior strength and means through an application of specific force and power. Both notions of the hard and soft styles of martial arts are necessary in the stances of The Fight Club for educational researchers, the styles are thus akin to the different methodologies and stances invoked in the Principle of the Cat. Every style is needed in different ways in the various rules of fight club as a specific form of rhetoric coming from a specific theoretic-activist stance.

The first rule of Fight Club becomes transformed to: You do not talk about Learning.

This is similar to Gert Biesta's problematization of the language of education (Biesta, 2005), and particularly learning. Talking about Learning has a certain romantic odeur to it, as if Learning isn't happening within institutions, through problematic practices of teaching, and in the overall frame of inequality in the educational system; an educational system where the Matthew effect[xxi] is in full bloom and has been so in the recent centuries (Merton, 1968a, 1988). The style first applied here is the *soft style* in a graceful aikido disarmament, avoiding a specific term, always staying away from the infested word of Learning, unless it is connected to the structural problematic and stated in intensive terms. The *hard style* comes into play when the partner/opponent/'educated other' insists on using the word learning, no matter how evasive one were in the soft style. Then it comes down to a hard flurry of attacking blows asking the partner to be explicit about what learning is in terms of ontology/institutions/knowledge thus reflecting and redirecting the issue of Learning to where it belongs.

The second rule of Fight Club becomes transformed to: You do not talk about Learning as "Brain research shows…"

One of the most problematic discursive and bodily changes seen in the last few decades has been the march of the Neurological Science into the educational domain, or perhaps more precisely the deterritorialization of Neurological Science into other previously unrelated domains. Similar to the way Science overall has deterritorialized other domains now a new specific flow is in progress. Every thing is transformed, in the name of Scientific Reason, into Neurological Science and a plethora of incarnations spring forth using the argument "Brain Science shows us that…". Evidence is riding that flow as well. Luckily for the trained martial artist and fight club resident the *soft style* first used here is a smooth neck choke. What happens to the brain, when it runs out of blood? Can you even talk about Brain research sensibly without referring to the multiple parts of the body? The notion of Brain Research can similarly be avoided and circumvented through a defensive stance, always standing within the center of the partner. The reductionist claims of Brain research are so fairly obvious that even the most diehard brain researcher avoids giving too much credit to the brain in comparison with the whole complex of

human activity. The Brain is an extended thing in the most concrete sense of the word! But does the partner still persist in the arguments regarding "Brain research shows…" there is no other option left but to resort to the hard style. The hard attacks comes easily, repeatedly, show me your "brain research", show me the 'evidence and the results' and the fight club resident will in turn unveil the illusio behind the claims, the flawed and improvable inference of results. It is due time for a blitzkrieg of the flesh, against the dogmatic Cartesian supremacy of Mind.

The third rule of Fight Club becomes transformed to: Give the pupils/teachers the right to say stop, go limp and tap out.

Who has the power? Who decides what is best between the apprentice and the teacher? There is a smooth space available between the craftsman and his apprentice, between the wise and the innocent, between Batman and Robin, between old lived life and starting life. Teachers and pupils both know best - from the ground up. This means that the power/conatus[xxii] for both the pupil and the teacher to say stop to changes, stop to reforms, stop to evident teaching practices is a right of the body, an affirmation of joy, to not let sadness into the smooth space. Has there ever been freedom in Education? The way of the conatus is the only way forward, through the power of joy. This is easily transferred to the stances of fight club. The right to say stop, go limp and tap out can be found in the *soft style* by simply not-engaging, not-participating, refusing to do stupid things - that applies for the teacher as well for the pupil. What could, in the worse case, happen? Can someone force you not to stop? Can someone actively propel you into movement? There is an activism in not participating as shown by Peter Pal Pelbart's theater group, by not participating in specific activities (Pelbart, 2013). The most powerful weapon of the unions have always been the strike, now deemed 'un-democratic' but when Denmark was occupied by Germany the series of strike in 1943 showed to be the best defense and activism against the Wehrmacht. Signing out of the rigged game, refusing IKEA-life, is the whole fundamental idea behind fight club. In hard style this becomes different. If forced by different powers into some kind of stupendous activity, even though one have repeatedly attempted the soft approach, one becomes forced to assume the stupidity for one self, to become stupid in the meaningful sense. (The danger is of course here being proclaimed stupid, deemed not worthy listening to and referred into belonging to a specific political box or stance). This can be done by engaging in a series of hard deflecting and visible maneuvers to show the partner that this is really a waste of time and energy, to accomplish the task with a bare minimum of investment, to show with humor how this activity, evaluation, report etc. really is Kafkaesque and a part of a game not worth participating in.

The fourth rule of Fight Club becomes transformed to: Only the Teacher & The pupils fight.

Who is this all about? Education is put forth as if it is about making patriots, making productive citizens, getting a job so one can start acquiring a debt to the banks, assuming a specific competitive career to benefit the Nation state and so forth.

> The problem of education is not an ideological problem, but a problem of the organization of power: it is the specificity of educational power that makes it appear to be an ideology, but it's pure illusion. Power in the primary schools, that means something, it affects all children. (Guattari, 2008, p. 38)

Mass schooling is in itself a specific power exercised to produce patriots, and no other place was this more visible than in Prussia in the 19th century. Prussia had to 'construct' a new patriot, which could defeat the rising French and especially the upstart Napoleon and his rabble of plebs. Mass schooling equally serves as a way to place children, within a striated space, in certain amount of hours pr day so the parents can be productive - supporting the production of the Nation state and the apparatus within. Let us image that mass schooling disappears for a just a split second, a Flash, what is then left but a teacher/old life who has lived a little longer, seen a little more, suffered a little more, acquired a few more skills and a pupil/ new life ready to explore the world and its creations. Couldn't these two personae meet in a smooth space, an open ground with nothing but the sky above and the horizon to all sides? Institutions, leaders, and politicians have a tendency to impose more and more ideas into that specific space of education. Other fields state that education should always be something more than just a teacher and an apprentice. It should be a specific kind of moral (sustainable, economic, sexual), it should prepare for democracy (whatever that means), it should be sensible, it should be measurable. What happens if the teacher and the pupil insist on the basic relation between bodies in a different state of decomposition and rest?

To avoid all those extra curriculum activities and intentions the soft style becomes applicable through simply focusing on the circular movement of the martial artists, nothing matters but the circle, not the partner trying to persuade you into another movement, not the attackers from the sides. Only the outward/inward circular movement matters. No martial art excels at this better than aikido, the unbroken circle, the circle that repels all aggression and exalts a specific bodily focus. The hard style can be used as well, but not as a first response. If the martial artist and fight club participant are forced into a specific posture, kicked to the ground, pushed, or grappled the important thing is to regain the posture at all costs, to get back into the fighting stance. One never stays on the back, stay grabbled but keep focusing the energy in short bursts of force to re-claim a fighting stance, which can meet all assailants. Nothing disrupts that stance but ones own conatus and joy, not sadness, not anger or aggression, and especially not desire.

The fifth rule of Fight Club becomes transformed to: One fight with Capitalism at a time.

Teachers and pupils are overloaded with tasks to do, to rebel against, to say no to, to refuse. Fight club is though, in its core idea, a resistance of capitalism and its connection to bio-power - the specific delirium of capitalism and the desire it promotes. Capitalism is the main adversary, the other problems resembling epi-phenoma in that regard. The fight club credo "one fight at a time" is a practical stance. One fight with capitalism at a time. One doesn't fight the hydra by cutting off its heads, two more will respawn from the one you have just slain. You go for the body. You go for the heart.

Capitalism's heart is the deterritorialized flows, everything becomes a form of capital, and none showed this better in the real than Bourdieu's analyses(Bourdieu, 1984, 1998, 2005). The aim is thus here to point out the fallacy of educational researchers stuck in improving practice, creating new tools for learning (which are backed by specific companies looking for profit), assuming that teaching is neutral and so forth. There is always a hydra (as an aspect of capitalism), in the room for the fight club artist to point out and attack. There is always the clamour of *"Hail Hydra!"* echoing in the halls of Education. It exists in geography, mathematics, research, physics and so forth. *"Resistance is futile"* says the Borgs from Star Trek (Roddenberry, 1987), but just to resist is to be alive, to be vibrant and intensive.

The *soft style* most useful here would be the throws associated with aikido, jiu-jutsu and judo. The partner engaging in aggression, or an activity, which to him is unknowingly connected to a specific capitalistic desire, is thrown gently in another direction, where it hopefully becomes evident that the aggression really was originating from a specific form of capitalistic induced desire, whether it is lust, greed, sloth etc.

The hard style has it uses here as an aim to redirect capitalistic desire through a simple appliance of bodily pain, a hard jab to the nose, a kick to the groin. Showing the partner how the body consists of flows, multiplicities of bodies, which doesn't assume capitalistic forms but cooperate in another sense. Showing how one 'from the ground up' consists of intensities, not capitalistic entities or money-making molecules, has the possibility of throwing the desire off balance. When one is dazed from a blow, suffering from a bodily pain one has the opportunity to see clearly to readjust and demolish values and desires.

The sixth rule of Fight Club becomes transformed to: No tool is a necessity, No method should distract you, No methodology should confine you, No epistemology should limit your gaze.

Everything comes back to ontology and everything 'above' that can be devalued. Intensity, bodies and Spinoza's rallying cry "We don't even know what a body can do" (Deleuze, 1990; Spinoza, 1996) Too often educational researchers become lost in their methods, beguiled by their own tools: " I only do interviews", "I am fond of the qualitative kind of data", "Statistics is the only evident method" and so forth ad finitum. Educational researchers becomes compartmentalized, organized in specific subfields and camps, they become 'educational ethnographers', 'educational sociologists', 'educational x'. None saw this clearer than Bourdieu in *Homo Academicus* (Bourdieu, 1988). A specific form of academic and scientific capital organizes research and researchers – knowledge becomes a capital in every deterritorialized field and domain.

When one is tasked to give an account of the truth and 'value' of ones specific method, methodology, and epistemology - the *soft style* can help the researcher and fight club attendant. The soft maneuver to use is, again, a redirection of force, turning the applied force by the attacker/partner into a circular movement and inspiring the partner to follow one in the same circular movement. Again no martial art is more adept at that than aikido. The attacker/partner will then be let to question himself, the problem itself, not through an invalid solution, but a non-sensical question. Why ask about methods, methodology, epistemology, when it really comes down to ontology and when research ethics in itself is a question of ontology. The *hard style* chooses a different path to oppose and counter such an attack and response. It trades attack by counter-attack, in a Hannibal Lecter-ish quid pro quo stance. When asked about the method in use, it retorts back to the attackers own flawed method. When questioned about epistemology it points out the splinter in the attacker's epistemology's eye. Every tool, concept, method, methodology, epistemology has a flaw, a crack in it. That is how ontology shines through. Exposing this crack, leading the partner to realize the necessary self-destructive nature of every tool is adamant for the fight club member. Everything must burn in the end to make room for new life, new knowledge, only the third kind of knowledge lives on. Educational research must be this gasoline, this dynamite, and this cleansing fire/flood. The Joker knew that more than anyone else.

The Chechen: Joker-man, what you do with all your money?

The Joker: You see, I'm a guy of simple taste. I enjoy dynamite, and gunpowder, and gasoline!

[he pours gasoline on the mountain of cash]

The Chechen: [panicked] What the...?

The Joker: Ah-ta-ta-ta-ta. And you know the thing they have in common? They're cheap.

(Nolan, 2008)

The seventh rule of Fight Club becomes transformed to: Changing the molecular rules of the educational game takes time

Change takes a certain amount of time, whether it is boiling water, learning to dance, writing a book or replacing capitalism. Every change starts as an event, a singularity, from the ground up. This means that everything starts with a body, which becomes connected into a series and so forth. Changing the educational game starts thus in the minuscule, by forming relations, finding partners, every movement in Thought starts with a singularity. Every change needs a certain amount of antagonism, a certain amount of resistance. Violence has historically been used to support change but it always backfires. Violence more than anything creates specific forms of resistance boiling and erupting into revolutions, wars, disruptions. The fight club creed is about resistance, not violence, it is about creating and carving a smooth space within an oppressed regime of truth, it is about deterritorializing the smooth flows of capitalism with intensive bodily flows. It is about replacing a stunted rigged game of chance with a pure game of chance.

> *It is not enough to oppose a "major" game to the minor game of man, nor a divine game to the human game; it is necessary to imagine other principles, even those which appear inapplicable, by means of which the game would become pure.* 1) There are no preexisting rules, each move invents its own rules; its bears upon its own rule. 2) Far from dividing and apportioning chance in a really distinct number of throws, all throws affirm chance and endlessly ramify it with each throw. (…) *The ideal game of which we speak cannot be played by man or God. It can only be thought as nonsense. But precisely for this reason, it is the reality of thought itself and the unconscious of pure thought.* (…) This game, which can only exist in thought and which has no other result than the work of art, is also that by which thought and art are real and disturbing reality, morality, and the economy of the world. (Deleuze, 2004b, pp. 70-71, my emphasis)

Every change is in thought. Every combat move in Fight club is about engaging thought, becoming a martial art in a lived body. This requires the persuasive maneuvers of the soft style, the circular circumvention of all capitalistic flows, directing them in new novel ways. It needs the rigorous punches and direct

applications of force, conatus of the hard style, the direct laugh, humor and joy, which spark thought and encapsulate sad passions and the capitalistic delirium.

The eight rule of Fight Club becomes transformed to: If you are a researcher in education you have to fight.

Education is a very specific field of struggle. It is a field everyone passes through, a field, which acts as the breeding pool for every other citizen and subsequently forms their function in the nation state. The field of education is thus a field heavily laden with interests, influence, and deterritorialized flows of capitalism. The field has an enormous impact on the trajectory of the nation as a whole, especially in the new globalized economy, where we have entered a new higher education arms race. Thus Fight Club and Project Mayhem have no better place to initiate a movement towards late capitalism than in the educational field. If there ever was a utopia on the horizon it has to start with education 'winning hearts and minds'. It all starts with the educators, the pupils, and those researchers who initiate the link, questionable as it though may be, between education and 'educational science'. Education has been deterritorialized by science making the 'educational experts' influential assets in initiating a change. The educational researcher has to bear witness to the 'divided subject' - the individual in intensity - and initiate a movement above and beneath the individual [1,1]´´. To do that, the educational researcher needs masks, they need to 'use the weapons of the enemy', play dirty with low kicks, groin kicks, and rhetorical nonsense. The educational researcher needs to initiate a splitting between the Structural Hero ∫ Structural Villain, acting as dx/dy, and assume the fighting Principle of the Cat.

Ave Capitale, Nos morituri te salutamus

You walk into the room
With your pencil in your hand
You see somebody naked
And you say, "Who is that man?"
You try so hard
But you don't understand
Just what you'll say
When you get home
Because something is happening here
But you don't know what it is
Do you, Mister Jones?

(Dylan, 1965, Ballad of a Thin Man)

The smooth cube of Power

With great power comes absolutely no responsibility

(Eminem, 2013e, Rhyme or Reason)

With great power comes great responsibility

(Voltaire, 1996)// (Lee & Ditko, 1963, Amazing Spider-Man)

[233,377]´ SOWING A NEW IMAGE IN THE FIELDS OF POWER

> Every fairy tale needs a good old-fashioned villain. You need me or you're nothing. Because we're just alike, you and I, except you're boring. You're on the side of the angels. (Haynes, 2012, statement by Jim Moriarty)

[377,610]´ THE FIRST METHODOLOGY OF NON-SENSE

The room is a battlefield, the first and perhaps eternal battlefield of thought. Everywhere lies broken concepts, broken ideas and bodies, it is if a monstrous force is chewing them all up and leaving them decomposing on the field; everywhere the Structural Heroes turn there is the trace of the great devourer. The devourer itself has though retreated to another part of the labyrinth to avoid the coming battle. The field/room itself is endless, in the horizon buildings, institutions and nation states tower, encapsulating the whole field and creating the frames, walls and demarcations for the struggles. The institutions now bear the signs of tests, measures, evidence, PISA, dollars and euros. In this room the Structural Hero is first divided in two simulacra, in Speed ⚡and Will ⓪. The enemy, the Structural Villain inhabits every structure on the field, remaking them into a cybernetic image, a version of himself and his workings. Brainiac desires only one thing - assimilation: obliteration by incorporation, to remake everything, every structure into a specific reasonable, calculable image. This Structural Villain has manifested in many places before - an eternal enemy spawned in the Antique. Contemporary DC Comics name him Brainiac, Alan Moore split him into Dr. Manhattan ∫ Oxymandiaz, Markowski-brothers called him Mr. Smith/The Matrix, Mary Shelley called him Victor Frankenstein, Thomas Harris named him Hannibal Lector and Arthur Conan Doyle reversed him into a split hero, Sherlock Holmes ∫ Moriarty. The series and manifestations of the Science-Image is endless and began in the first instance of the series of Science, which created this dream of non-sense of everything explained by rational thought, by Reason.

The Structural Heroes are fighting this enemy. The Flash is moving with impossible Speed mapping the Science-structures wherever they appear, tracing a diagram of where the new manifestations of Brainiac appear, where new transformations of structure take place: in gymnasium, curriculums, children shows, sit coms, food programs, fitness videos and so forth. The manifestations are endless and only one equipped with the Speed-Force can hope to trace this infinite/infinitesimal series of manifestations – of Science- Structure inserting itself in new domains. The Green Lantern, will personified, is following the structures themselves, creating parallel structures wherever the enemy arises, creating clear visible images to combat the enemy, mimicking the tools of the enemy and turning upon the enemy itself.

Everywhere there is a cat smiling a Chesire smile. The Principle of the Cat is being invoked here, and the outcome is certain. This is the first battleground versus Brainiac and the heroes have just begun to assemble. In the distance a great flood is coming, a Movement of water and depths, coming to wash structures away and to draw upon the strength of the deep. Aquaman is riding those waves and all the endless bodies of the seas are behind him.

[610,987]´ A METHODOLOGY OF SENSIBLE MAPPING

The first problematic which arose early in trajectory of the PhD investigation was the problem of power-science, power-economy-science, and power-scientific knowledge and how to assemble/construct a methodology for the investigation and diagnosis. Both Foucault and Bourdieu had called for an investigation of the 'serious sciences' or the 'scientific field' (Bourdieu, 2004; Foucault, 1970, 1972). Thus from the very beginning of the research 'outline' the overall problematic of power and education and the reading of Foucault/Bourdieu forced the direction of the exploration and of constructing a methodology, in a new Image of Thought, equipped at investigating the problematic of recruitment into the natural sciences and shaping the trajectory of the youths through various practices.

This problematic was reproduced in the Youth-to-Youth Project and seemed an intrinsic part of related bridge-building projects both in Denmark and internationally, which again was related to an overall problematic of science education or education itself. For example a question was put forth to the Structural Hero by an anonymous partner in the YtY – Project: *"Can you make a survey, which can identify the youths the YtY - project want to address and help?"* The Youth-to-Youth project thus seemed as if it was a particular manifestation of that problematic and wanted to identify and help the rural confused youths. The article *Between the Cat and the Principle: an encounter between Foucault's and Bourdieu's conceptualizations of power* and the Movement of Thought therein was an attempt to gather a methodology of the Janus face, of Fight Club, to invoke a split in the researcher. From the beginning of the investigation there had been this split, between the PhD research and the Project, between being a PhD student and a

developer and evaluator of the Youth-To-Youth Project. Instead of seeing this split as a problem and hindrance, the Structuralist Hero embraced it as a marvelous opportunity of having two kinds of investigations, two almost opposed forces working on the same problematic.

Alongside the work on *"Chasing the Chimera's Tail's: an analysis of Interest in Science"* and the problematic regarding Interest in Science, the concrete case of representation and the quantum in physics was investigated to provide a case example of the problem of power/science and how to create a new Movement to explore the problematic. The problem of representation of power, of reaching a point of sufficient reason of the elusive object=x, was linked to the structuralist problematic of catching the great mover and machine behind the structures. Particularly I was intrigued by the Solvay conference of 1927, a specific event, which both introduced the new model of the quantum and similarly created a schism, or was the real scene of the schism, between the top physicist of the world with luminaries such as Albert Einstein, Niels Bohr, and Erwin Schrödinger. This event seemed worth gazing upon and recreating with a new Image of Thought of the Principle of the Cat. Originally I had written a much longer paper but due to constraints I was forced to cut the analysis of some of the key players at the conference. This analysis of scientific capital through the biographies of the participants will instead be outlined here, as a concrete example of how to understand an event through the lens of Bourdieu's forms of capital.

Practically the double Movement, the Principle of the Cat, simultaneously made the investigation proceed on two levels, planes or stratum of investigation, one of sociology connected to Bourdieu's work and one of history of ideas connected to Foucault's work. Through connecting these two machines, or planes of investigation, the Structuralist Hero attempted to reach the object = x in science in the structures before him.

[987,1597]´ THE SOLVAY CONFERENCE 1927 - AN ADDENDUM

The Addendum below should be inserted/read after page 143 of the thesis (or after page 23 of the article *Between the Cat and the Principle*)

[1597, 2584]´ THE ARGUMENTS IN PERSPECTIVE

One could claim that the better physicists or science 'won' at the Fifth Solvay Conference, they clasped hands and everyone walked from the conference in relative peace, but as Bacciagaluppi and Valentini (2009) remarked, that wasn't the case. The problems and conflicts over the quantum were never resolved and the recessive discourse of the old classical objection to the new paradigm or 'indeterminate worldview in the microcosm' kept simmering, relived especially

with Schrödinger's Cat Paradox (Schrödinger, 1935) and Einstein's various thought experiments (Lindley, 2008). What is interesting if one were to put the above arguments and unresolved conflict/problem under the Bourdieuian and Foucauldian gaze, a new question emerges. Which social and structural factors could have played a part in making the Bohr-faction the winner of the conference? To explore that vista one has to turn to the structural factors of the actors, and the conditions of possibility surrounding the discourses regarding the 'new' vs. the 'old' paradigm or èpistèmé.

[2584,4181]´ THE STRUCTURES SURROUNDING THE FIFTH SOLVAY CONFERENCE

[4181,6765]´ THE BACKGROUND

For scientists to meet internationally was no small endeavor in 1927, especially the lauded physicists of Europe, whom either had a Nobel Prize or received one in the years following the conference. Since WWI and the signing of the 1914 declaration "An die Kulturwelt!" by 93 acclaimed German scientists, physics and science had become threatened by ideology and infected by political and nationalistic discourses. In 1927 the German scientists where included for the first time since 1914 owing in no small part to the effort of Albert Einstein (Bacciagaluppi & Valentini, 2009). Another reason for letting Germany back into the fold was due to the fact that Germany, at the time applying for the League of Nations.

The Fifth Solvay Conference thus stood in the light of a new hope of unification in Europe, where scientists were gathering from nations, whom just a few years back had been in war.

The Fifth Solvay Conference was located in Brussels, Belgium, which was invaded by Germany in WWI. The theme of the conference was originally proposed to be on the theory of radiation and light quanta, but breakthroughs in 1926 and 1927 changed the theme to quantum theory; especially Schrödinger's wave mechanics (from the Einstein-faction) and Heisenberg's findings were to be presented at the conference. What is interesting given the aftermath and discourse on what happened at the conference was that neither Bohr nor Einstein presented at the conference. Rather their contributions lay in the discussions of the proceedings put forth by their respective followers. Again remarkable in the sense of the conceptualizations of power and scientific capital, it was very much the organizers of the conference, Lorentz and Ehrenfest, who decided in correspondence with each other who was/ was not included in the good fellowship of physics; it was an invite only conference and limited to about thirty persons. The guidelines sent out to the presenter's gives an interesting view of the scientific discursive formalization expected of the scientists:

> "The general guidelines were: to focus on one's own work, without mathematical details, but rather so that 'the principles are highlighted as clearly as possible, and the open questions as well as the connections [Zusammenhänge] and contrasts are clarified'. The material in the reports did not have to be unpublished, and a bibliography would be welcome." (Bacciagaluppi & Valentini, 2009, p. 19)

The conference took place from the 24t h– 29th of October at the Institute of Physiology in Solvay. Since participants and presenters were speaking French, German and English a lot of translation was going on at the conference. There is also the famous Babel quote from the Bible ("The Lord did there confound the language of all the earth"), which Ehrenfest put up on the blackboard during one of the discussions - seemingly as a metaphor for both the multiplicities of language and the controversies going on in the discussions (Bacciagaluppi and Valentini 2009)(Cassidy, 1992).

To summarize at least three specific structural conditions were of critical importance at The Fifth Solvay Conference: 1) The placement in the scientific field of the German scientists 2) The location of the conference in Belgium 3) The specific role of the chair and organizers of the conference – Lorentz and Ehrenfest and how they structured and prepared the conference in the years leading up to the event in 1927.

[6765,10946]´ THE PLAYERS AT THE CONFERENCE

Bourdieu proposes that to examine the scientific field one must look at the agents, their habitus and accumulated scientific capital:

> "I shall now attempt, with much hesitation, a very risky undertaking – endeavouring to characterize two scientific habitus and to relate them to the corresponding scientific trajectories. My main aim in so doing to give an idea, or a programme, of what a refined sociology of science would have to do." (Bourdieu, 2004, p. 43)

In the case of The Fifth Solvay Conference one would therefore need a characterization of the habitus of the involved agents and key players at the conference. That would be [Lorentz, Ehrenfest] (the organizers), [Bohr, Born and Heisenberg] (the Bohr-faction) and [Einstein, Schrödinger] (the Einstein-faction). Other players could be relevant especially those who commented heavily on the various presentations and took part in the Bohr/Einstein discussion. In other words can one somehow get a Bourdieuian understanding of why the Heisenberg /Schrödinger or Bohr/Einstein controversy ended with one deemed the winner and the other cast into silence in regards to quantum theory? Such a thorough undertaking is though beyond the scope of this article. In the following this paper

will merely emphasize key differences between the habitus of Schrödinger and Heisenberg to capture the point of Bourdieu's methodological departure in the habitus of the scientists. The problem subsequently arises of analyzing historical cases with the tools and concepts of Bourdieu, which were used on contemporary data. It is the claim here though that an appropriation of Bourdieu's concepts of capital and habitus can and is in fact very useful analyzing historical cases.

[10946,17711]´ A SKETCH TOWARDS A SCIENTIFIC HABITUS OF SCHRÖDINGER

In the following I will try to interpret and sketch out the scientific habitus of Erwin Schrödinger (1887-1961) in specific relation to the arguments and structures at The Fifth Solvay Conference in 1927. The basis of the interpretation is his autobiographical notes (Schrödinger, 1992). This kind of qualitative data and the use of it is here seen similar to the way Bourdieu posits the qualitative interview (Bourdieu, 1999), though of course with certain limitations since it's a written text. The autobiographical notes won't be analyzed in a specific Freudian or psychological sense, though specific parts regarding the role of his father in relation to his interest in biology and clear representations and images of nature will be presented as a source of structure shaping his habitus.

Bourdieu's concept of Habitus (Bourdieu, 1977, 1984, 1988, 2004) is a sociological concept trying to advance a novel way of understanding how society and the specific fields shape an agent and how the practices the agent applies in the field are derived from that habitus. Habitus is an attempt to escape an imposed duality between subject and context or subject and practice; it's a relational mode of thought or gaze applied to the agents, and always from the point of view of the field. Habitus doesn't give any meaning without including contemplation upon the field and its form of capital. In the case of Erwin Schrödinger, what is of interest in the analysis of this paper is his specific scientific habitus, the arguments and practices he brought to bear regarding the quantum mechanic controversy. Three points sticks out in the autobiographical notes of Erwin Schrödinger (Schrödinger, 1992) 1) His Austrian cultural rearing and how it affected his career and training in science 2) His private tuition and influence of his father regarding biology and view on nature 3) His abstention of overcomplicating theory and seeking a form of unified theory derived from observing nature, notably he was interested and inspired by the philosophers Schopenhauer and Spinoza. These three points pin him directly against the theorization posited by the Bohr-faction, and Heisenberg's scientific habitus and person in particular. Of particular interest are the reactions towards Schrödinger, thus giving an indirect gaze upon his scientific habitus. Einstein saw in him a traditionalist saviour of the quantum controversy during their meeting in Berlin in 1926 (Lindley, 2008). Even after the 'loss' at the Fifth Solvay Conference Schrödinger continued, together with Einstein, to oppose Bohr's and Heisenberg's quantum mechanics, which among other thought experiments took the

shape of the Schrödinger's Cat Paradox. Schrödinger was at the time of the Fifth Solvay Conference an established physicist of forty years old, married and well brought up as a cultured Viennese in sharp contrast to Heisenberg's more rustic appearance and behaviour; in other words Schrödinger was part of the established old guard of physicists. By attending The Fifth Solvay Conference Schrödinger was set upon saving the old soul of physics (determinism and causality) with his wave equation; this would amount to no small amount of fame or scientific capital if he was to succeed and he was encouraged and put forth in his enterprise by Einstein. Schrödingers position in the scientific field of physics is thus seen as a specific product of capital (Vienese background, relation to biology and so forth), which shaped him into an advocate for 'the old guard of physics' and determined his strategies there and his relation with the other scientists in the field.

[17711,28657]´ A SKETCH TOWARDS A SCIENTIFIC HABITUS OF HEISENBERG

The basis for the following sketch of Heisenberg is biographical material as well as his own published works (Cassidy, 1992, 2000; Heisenberg, 1949; Pais, 1991). Werner Heisenberg (1901-1976) was a controversial figure and appears in much of the historical correspondence and memoirs from the players at the Fifth Solvay Conference (Einstein, Bohr, Schrödinger and many more). This is though only a sketch to emphasize a very different scientific habitus at odds with Schrödinger and Einstein at The Fifth Solvay Conference. Heisenberg's scientific rearing is very different than Schrödinger's. He hailed from Bavaria in Germany and attended universities in Munich and in Göttingen. Werner Heisenberg was a 'natural mathematician', which wasn't that common among physicists at that time. Several points stand out in Heisenberg's scientific habitus as compared to Schrödinger's: 1) An affinity for mathematics as well as physics 2) Early mentorship by Arnold Sommerfeld, which also was the early mentor of Niels Bohr; Sommerfeld accepted and encouraged the radical and maverick approach by Heisenberg 3) He wasn't as classically schooled in physics as Schrödinger and was willing to try new novel and radical approaches. Heisenberg was only 26 years old at the time of the Fifth Solvay Conference and Niels Bohr's assistant, whom encouraged and constantly challenged his ideas regarding The Uncertainty Principle. In other words Heisenberg was, at the time of the Fifth Solvay Conference, just starting his entry into the scientific field and his position was yet to be determined and recognized among the other players in the field.

[28657,46368]´ THE CLASHES OF HABITUS – THE YOUNG TURKS VERSUS THE ESTABLISHMENT

The above two sketches are only meant as an example of how critical and encompassing the divide was at the Fifth Solvay Conference. Two gurus Einstein

and Bohr had assembled a gathering of disciples and put them forth as presenters at the conference. The organizers of course accepted these proposals and attendents, since they were the major figures in quantum research. What was at stake was no less than the soul of physics or the old paradigm versus the revolutionary one – determinism and causality against indeterminism and probability. The strategies manifested by the players invoked by their different scientific habitus came to the fore. Schrödinger's presentation drew, in Einstein's words on a 'beautiful classical image of nature' (Pais, 1982), where Heisenberg drew on mathematical formalism; in short they demonstrated their specific scientific habitus in their discursive presentation of their work and theories. But as Bacciagaluppi and Valentini (2009) shows us there was no 'report' deeming one faction the winner and the other the loser, there was an unofficial discursive argument and the agents with the best strategies in those specific conditions of possibility (Fifth Solvay Conference) 'won'. The outcome of The Fifth Solvay conference was thus merely a rhetorical and discursive one, not a factual. Was the outcome then arbitrary? No far from. The discoveries leading up to the 'invention' or discovery of The Uncertainty Principle started with Einstein's own relativity theory, but how the agents positioned themselves in the subfield of physics was a deliberate positioning and dance of scientific capital and habitus. What many historians deemed crucial was that the role 'new mathematics' acquired an increasingly larger role and the old establishment had problems keeping up with the new formalistic language of probability and how it affected the perception of physical reality (Cassidy, 1992; Pais, 1982, 1991). The old divide between experimental and theoretical physicists was no more adequate to explain the differentiation between the agents in the subfield of physics. In summary, Habitus can thus be used to provide an analytical tool in a scientific debate within a specific field, one that examines both the agents and the theories/strategies they apply and doesn't reduce the importance of either.

[46368,5^2·3001] THE EVENT

What is missing from the above sketching of habitus and scientific capital is role the specific event, conceived as structural circumstance or conditions of possibility, plays in the outcome. The claim of this article is that The Fifth Solvay Conference represents such an incident and singularity and precisely the notion of The Event/eventalization is where Bourdieu's notion of scientific capital and habitus has to be appropriated to a Foucauldian and Deleuzian approach (Deleuze, 2004b; Foucault, 2000). The Fifth Solvay Conference was a special historical event and in the scientific field of physics and beyond - akin to what the Battle of Jena, for example, represented for the new development and direction for the Prussian State. Like the court gatherings in the late middle ages, where the nobles met to forge alliances, arrange marriages and otherwise exert their social capital, The Fifth Solvay Conference was a display and gambling with scientific capital. An event such as The Fifth Solvay Conference has the potential of rearranging the field with regards to capital, depending of course on the conditions of possibility surrounding

the agents. This doesn't mean there wasn't a lot of build up to the event, both discursively in the letters between the scientists, breakthroughs in areas of physics, and other correspondence between the different agents. In fact David Lindley advocates that Einstein was unprepared to present a proper critique against The Uncertainty Principle, and that was why he retracted his paper from the conference (Lindley 2008). The event was very much a climax or boiling point of the subfield of physics at that time. In other words the potential for a rearrangement of the scientific field was there, but the form and shape it took at The Fifth Solvay Conference couldn't be regarded or reduced as arbitrary. The idea of change in the scientific field needs this notion of a catalyst in the form of specific event set in specific structures or conditions of possibility and the conference in Belgium was such an event.

[5^2·3001,233·521] A SUMMARY OF THE HISTORICAL CASE AND MOVING BEYOND

The presentation of the historical case of The Fifth Solvay Conference in 1927 and the divide in the subfield of physics has aimed to demonstrate how the following concepts are needed to unravel a paradigm change or controversy within a field: 1) The Bourdieuian and Foucauldian notion of field, as a site of specific forms of capital, habitus and practices – a field always has it own laws and rules of legitimacy. 2) The Bourdieuian notion of habitus as a tool to analyze the agents, their discursive strategies, and their theoretical preferences 3) The Bourdieuian notion of scientific capital as a tool to analyse how agents position themselves according to factions or camps due to theoretical preferences. Again this could be regarded as arbitrary, but is in fact closely related to their specific scientific habitus 4) The Foucauldian/ Deleuzian notion of The Event/eventalization as a way to understand the historical conditions of possibility and the way the structural setting frames the agents and their arguments. These four concepts are related to how power works in a field. They are an assortment of different gazes looking at the bigger picture of power.

In the following I will return to the subject of power and how the analogy to quantum mechanics helps us transfer the methodological insights from the above historical case to a contemporary analysis of the educational field.

[233·521,196418] FIRST EPILOGUE - AFTERWARDS ON THE STRUGGLE

Brainiac was exposed and defeated for now. The eternal adversary never stays dead but has retreated into another part of the labyrinth working his assimilations. The Sructural Heroes were saved by the depths, Aquaman's force and power swept everything away leaving watery puddles everywhere on the field. But the Heroes

stand stronger than before, between lies a orange-red figure, sleeping blissfully on a pillow. A fat cat smiling a Chesire smile. It yawns, winks and opens its eyes, one green and one fiery red, one infinitesimally nearsighted and one endlessly longsighted. The Heroes have gained a new ally in the struggle ahead.

[196418,317811] SECOND EPILOGUE - MOVING FASTER

The Principle of the Cat, the Movement within the article, served as the overall approach of the thesis, a double Movement of constantly mapping two series simultaneously. The representation of power in the scientific field was the first case examined and merely outlined. But the course was now jaggedly set, a further exploration between Bourdieu's and Foucault's notions of fields seemed immanent, and through Deleuze's thought I needed a new fresh image to set up that encounter of fields. Similarly the survey, mapping of the discursive formation in conjunction with the YtY was undertaken, to speedfully map the structures of the region of Northern Jutland in terms of choosing a career in science. It seems as if the Structural Hero had to move with impossible Speed and as in Lewis Carroll's work, the Structural Hero had to move twice as fast just to stay in the same place…

"Well, in OUR country,' said Alice, still panting a little, 'you'd generally get to somewhere else—if you ran very fast for a long time, as we've been doing.'

'A slow sort of country!' said the Queen. 'Now, HERE, you see, it takes all the running YOU can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that!" (Carroll, 1917, p. 24)

[317811,514229] ARTICLE: BETWEEN THE CAT AND THE PRINCIPLE

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Between the Cat and the Principle: an encounter between Foucault's and Bourdieu's conceptualisations of power

LARS BANG
Institute of Learning and Philosophy,
Aalborg University, Denmark

ABSTRACT This article explores the benefits of an encounter between Foucault's and Bourdieu's different conceptualisations of power. The two approaches to power are considered by contemporary research to be irreconcilable, but this article claims that, by engaging both understandings, it is possible to draw a more nuanced map, one which is especially suited to research in power and discourse in educational fields. The article draws on the controversy between Heisenberg's uncertainty principle and Schrödinger's wave image (later formulated as Schrödinger's cat paradox) regarding the nature of the atom as an analogy to show why both conceptualisations are needed in order to understand the nature and manifestation of power. Does power operate as a hierarchy within the field, shaping the practices and habitus of the agents through various forms of capital (Schrödinger's wave image)? And is power distributed across fields and is it only through an archaeological and genealogical analysis that it is possible to get a glimpse of power, which is as elusive as Heisenberg's matrix theory (Heisenberg's uncertainty principle)? Analysing educational fields through an approach drawn from Bourdieu, the article applies sociology-specific methods to measure, quantify and visualise power on a contemporary, manifested and present level. Using a Foucauldian approach, it analyses the history of the present in order to understand how the above dilemma came to be and how it is distributed across various discourses, institutions and practices. It is argued that, when analysing power, a destabilised marriage between Foucault and Bourdieu is needed.

Representing Power

Power is both a visible and invisible force. In one movement it shifts forms, changes representations and tries to evade the gaze of the viewer. In the other movement it makes its appearance very visible, articulate and violent. Power is both resistance and domination, locked in an intricate dance. Educational research needs a methodology that is equipped for gazing upon both movements: the visible and the invisible, the articulate and the silent, the immeasurable rationality and the measurable capital.

The number of studies of power has exploded since Foucault's authorship (Rabinow & Rose, 2003), and power has become a topic of interest throughout the academic field. This article proposes the analogy that the *representation* of power has been ascribed the same importance as the quantum had in 1920s physics. Deleuze (2006, p. 59) writes that: 'power is a relation between forces, or rather every relation between forces is a "power relation"'. Power has become the 'relational essence', or the rudimentary concept, throughout social space, akin to how the quantum was the innermost working of the atom. The quantum was the key to explaining new advances in physics and became the philosopher's stone early in the twentieth century. Similarly, through an exploration of how power behaves and is manifested, the contemporary claim is that we can begin to understand how society works and operates on its subjects. Power is thus at the root of the genesis of understanding the social world or, in other words, the prime mover in the social world.

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Thus, the academic claim to owning the definition or representation of power has become immersed in the *fields of power* in the academic field: *the representation of power has become a power struggle in itself*. The genesis of the problem of representation, to which the problem of representing power is connected, is linked to an event in the scientific field in 1927.

In order to examine such an event, this article proposes an encounter of opposed epistemologies and methodologies in terms of representations of power – a productive theoretical encounter between Pierre Bourdieu and Michel Foucault – and sketches out a framework that is equipped to explore the multiple natures of power in both their elusiveness and materiality. The encounter between Bourdieuian and Foucauldian thought is not random, but is articulated here as an encounter between two clashing and opposed epistemologies in French thought, both of which have power at their centre. Bachelard and Canguilhem heavily influenced both thinkers and epistemologies: Foucault wrote the introduction for, and praised them in, *The Normal and the Pathological* (Canguilhem, 1989), and Bourdieu explained in *The Craft of Sociology: epistemological preliminaries* (Bourdieu et al, 1991) how his crucial epistemological break and new sociology were built upon their work. It may thus appear strange that they ended up somewhat opposed in their contemporary academia, with only Bourdieu referring directly to Foucault's work (Wacquant, 1993). This epistemological cleft, or rupture, is an effect of an epistemic divide, the ripple of indeterminism, within the philosophy of science regarding representation, transformed into a difference in the representation of power. A number of authors, especially French thinkers, have commented on this crisis of representation (Foucault, 1970; Bachelard, 1984; Deleuze, 1994; Whitehead, 2011). The Solvay Conference of 1927 is the event in physics that provides the backdrop for the justification of the Foucault–Bourdieu methodological encounter and an explanation for the fissure between the epistemological and methodological representations of power.

The argument is very significant for educational studies. An educational researcher interested in power will benefit from adapting a methodology posited in the very rupture of the epistemological divide between Foucauldian and Bourdieuian thinking, simultaneously destabilising Bourdieu with Foucault and Foucault with Bourdieu. No grand synthesis or peaceful complementarity of Bourdieu and Foucault is at work here, but rather an attempt to use one against the other in a singular two-pronged movement to represent power. Representing power is thus the overall problem of the article, and both the problem itself – the ripple of indeterminism emanating from the scientific field – and the way to overcome it lie in the aforementioned scientific event. Unless it is examined, the divide between Foucauldian and Bourdieuian thinking with regard to power will go unacknowledged as an epistemological rupture, beyond the authors themselves. This can, of course, also be seen as using a Foucauldian approach against Foucault's and Bourdieu's work itself. Both Foucault's and Bourdieu's representations of power [1] have undergone a development in their respective authorships, and their concepts are not of a static nature. Foucault (1994, p. 452), for instance, refused to be dubbed a 'theoretician of power'.

This article focuses on the encounter between the following Bourdieuian and Foucauldian strands:

- Bourdieu's notion of the field of power;
- Foucault's notion of field and rationalities;
- Bourdieu's sociological construct of the empirical field through forms of capital and observations of habitus/practice; and
- Foucault's specific historical method.

The central claim is that these four conceptualisations are critical to understanding this two-pronged methodology of Bourdieu and Foucault.

Outline and Encounters

The structure of the article is an encounter on different levels:

- An outline of the epistemological divide between Foucauldian and Bourdieuian representations of power and four strands of conceptualisations, and how they can be introduced into an encounter.
- An encounter between Bourdieu's and Foucault's concepts of field and rationalities.

- A brief investigation of a historical event (the Solvay Conference for physics in 1927), which created a crisis in representation – a ripple of indeterminism – that is visible in the contemporary representation of power.
- An encounter between the rupture of the event itself and the rationalities of determinacy and indeterminacy qua Bourdieu and Foucault. This creates a topology of Bourdieu–Schrödinger and Foucault–Heisenberg to enunciate the rationale behind the necessary two-pronged methodological movement.
- Finally, through the framework of the encounter, the article proposes the outline of an investigation of the relationship between the educational and scientific fields.[2]

Figure 1 illustrates a pedagogic schematic and somewhat reductionist topology of the analogies and claims of this article (adopting the parallel sign from mathematics).

The problem of the representation of power || The problem of the representation of the quantum.
The divide between Foucauldian and Bourdieuian epistemologies regarding the representation of power || The divide in a subfield in physics in 1927 (and subsequently in other, related fields)
Bourdieu's sociological construct of a representation of power through observation, habitus, and measuring/modelling forms of capital || Schrödinger's wave model and Schrödinger's cat paradox
Foucault's historical method of tracing the transformations of various practices, indirectly revealing a glimpse of a representation of power || Heisenberg's matrix mechanics and the uncertainty principle

Figure 1.

A Strange Case of Non-Penetration

The first 'truth', or obviousness, this article explores is the contemporary theoretical *exclusion* manifested between the epistemologies of Bourdieu and Foucault: How does the cleft between these two epistemologies regarding their representation of power manifest itself? In one of his final interviews, Foucault (1994, pp. 440-441) spoke self-reflexively regarding Frankfurt School/Weberian thought and his own thinking and methodology: 'It is a strange case of nonpenetration between two very similar ways of thinking which is explained, perhaps, by that very similarity. Nothing hides the fact of a problem in common better than two similar ways of approaching it'.

Foucault was obviously aware that his own thinking was historically influenced by the Nietzschean influence in French thinking, and how that excluded the Weberian and Habermasian rationality of reason. It is interesting, however, to note how Habermas (1985) seems to group Bourdieu and Foucault within the same lines of thought and theorising. Bourdieu's (1988a, 2000) later work problematises philosophy's role in the social sciences and their limited view of their own position in society. The following quote explains both his particular stance and his problems with philosophy:

> theory without empirical research is empty, empirical research without theory is blind. There would be no need reasserting such truisms if the division between theoreticist theory and empiricist methodology were not sustained by extraordinary social forces: it is in effect inscribed in the very structure of the academic system and, through it, in mental structures themselves. (Bourdieu, 1988b, pp. 774-775)

This division Bourdieu points to is strongly reproduced in the epistemological divide between contemporary Foucauldian and Bourdieuian representations of power. This divide can be crudely topologised as: (1) a philosophical representation of power, represented in this article by Foucault's (2000, pp. 326-349) work, which draws on a Nietzschean conceptualisation of power and genealogy; and (2) a sociological representation of power, represented by the work of Bourdieu (1989, 1998), which expands on a Durkheimian and Weberian approach.[3]

An example of this methodological and epistemological divide and how they seem irreconcilable is Callewaert's (2006) comparison of Bourdieuian and Foucauldian methodological positions. Callewaert points out how different their methodologies are, with Foucault using a historical and philosophical methodology and Bourdieu using an empirical and sociological approach. This article partly agrees with Callewaert's distinction between Bourdieuian and

Foucauldian methodology. However, Callewaert fails to take into account the *necessary destabilisation a theory regarding power needs against its own representations and proposed relations*, of which both Bourdieu and Foucault were very well aware. The encounter this article proposes thus destabilises one epistemological and methodological approach with the other, and proposes an epistemological approach regarding power in the very rupture between the two methodologies.

Bourdieu's Notion of Field and Field of Power

The first theoretical encounter between the conceptualisations of Bourdieu and Foucault is in the notion of *field*.[4] In particular, this notion is the very stage on which the dance of power operates, and it additionally acts as the framework within which the other encounters take place. Thus, creating a *field* of representation to understand power is of primary importance in the Foucauldian and Bourdieuian encounter. Bourdieu's (1977) concept of *field* was constructed as an ethnographic and anthropological entity. His notion of *field* is intertwined with the crucial formula [(habitus) (capital)] + field = practice (Bourdieu, 1984, p. 95). He thus expands an ethnographic concept into a sociological concept, where multiple correspondence analysis could be used to map out the dispositions of the *fields* in terms of economic and cultural *capital*. Bourdieu's work thus examines a multiplicity of *fields*: the educational *field* (Bourdieu & Passeron, 1990; Bourdieu, 1998), the academic *field* (Bourdieu, 1988a), the scientific *field* (Bourdieu, 2004), and so forth. Bourdieu's later works developed *fields of power* to expand his notion of the ruling or dominant class (Wacquant, 1993; Bourdieu, 1998). This notion of *fields of power* is seen here as an expansion or elaboration of power as a disposition or a space in the *field* of distributions, but it could be similarly viewed as a reaction to Foucault's notions and work. In an interview with Wacquant, Bourdieu directly addresses Foucault's notion of *power* in a discussion of the use of *fields of power* in *The State Nobility* (Bourdieu, 1998). The following lengthy quote is of key importance to the encounter between Bourdieuian and Foucauldian methodologies:

> LW [Loïc Wacquant]: How do these analyses differ from Foucault ... for example, for whom power operates via the 'training of the body'?
>
> PB [Pierre Bourdieu]: The differences are quite profound in my view ... In my view Foucault presents a simplifying vision of social constraint as discipline, i.e. as a constraint exercised upon the body from the outside ... But such analyses do not go beyond external disciplines and constraints, and Foucault ignores the whole process of inculcation of cognitive schemata of perception, appreciation and action, resulting from the internalization of the structures of the world and which, arising out of gentle violence, make gentle violence possible. *In short, lacking everything that I put under the notion of habitus*, Foucault cannot account for the much subtler forms of domination which come to operate through belief and the pre-reflexive agreement of the body and mind with the world – whose paradigmatic manifestation is masculine domination. (Wacquant, 1993, p. 34; my emphasis)

Bourdieu refers directly to Foucault's lack of *habitus* not as a concept, but as an account or measurement on a more localised and internalised scale than Foucault (1995) applied in *Discipline and Punish*. Bourdieu is, in other words, criticising Foucault for 'a simplifying vision' lacking an account of the 'process of inculcation' and 'internalization of ... structures'.

Bourdieu's new notion of *fields of power* is akin to a sort of background field intersecting the regular *fields*; it is still not a force in itself but a space of dispositions:

> The chain of interdependencies that sews them together into this peculiar ensemble Bourdieu calls *field of power* (a notion introduced in the early 1970s but elaborated for the first time here both theoretically and empirically) extends from the economic field, at one end, to the field of cultural production, at the other. (Wacquant, 1998, p. xi; original emphasis)

Bourdieu thus develops a notion of a multiplicity of specific *fields* (educational, political, bureaucratic, etc.) and a sort of background *field*, or intersecting *field*, which he calls *fields of power*.

Foucault's Notion of *Field* and *Rationalities*

Foucault is similarly operating with a notion of *field*; however, it stems not from anthropology or ethnographic notions, but from language and discourse. In order to elaborate, the Foucauldian *field* and its encounter with other Bourdieuian concepts need to be brought to the fore. Foucault's (1972, 1995) conceptualisations of *discursive* and *non-discursive formations* – clusters of discourse both verbal and material, and their genealogical distribution through various institutions and practices – are critical in understanding the power–knowledge relationship. A *discursive formation* is a structural amalgam of a series of discourses around a common theme. It is also the principle of dispersion and redistribution. Foucault writes:

> the law of such a series [of discourse] is precisely what I so far have called *discursive formation*, if I succeed in showing that this discursive formation really is the principle of dispersion and redistribution, not of formulations, not of sentences, not of propositions, but of statements (in the sense in which I have used this word), the term discourse can be defined as a group of statements that belong to a single system of formation; thus I shall be able to speak of clinical discourse, economic discourse, the discourse of natural history, psychiatric discourse. (Foucault, 1972, p. 121; original emphasis)

After *The Archaeology of Knowledge* (1972), Foucault (2010) used the term *rationalities* in his lectures and essays. I read this as being picked up to emphasise the genealogic distribution of *discursive formations*, thus expanding or clarifying his previous notion of archaeology. *I argue that rationalities are a different kind of dispersion and redistribution from discursive formations*. There is an intrinsic relationship between *discursive formations* and *rationalities*. The specific *rationalities* are Foucault's heuristic device to examine power–knowledge, power–body and power–subjectivity in relation to their distribution. The distribution of *rationalities* is dependent on a specific notion of field as the background for *the manifestation of rationalities* in specific domains.

In *The Archaeology of Knowledge*, Foucault (1972) operates with several *discursive fields*, which are dubbed here *virtual fields*, inspired by Deleuze's (2006) reading of Foucault. These *virtual fields* are inseparable from the *discursive formations*. They are not limited or fixed structures, but overlap a multitude of various practices, documents, and so forth. They are the enunciative background, or horizon, that organises the various *discursive* and *non-discursive formations* in statements, concepts and other linguistic structures. In short, the *discursive* and *non-discursive formations* and their distribution cannot be understood without this notion of the *virtual field*. A new *discursive formation* is a transformation of a previous *discursive formation* in accordance with the rules and dispositions of the *virtual field*. The *virtual field* and its organisation are historically constructed and closely related to the specific power and knowledge domains. In summary, without the notion of the *virtual field*, Foucault's critical notion of *rationalities* has no zone of re-enactment, so to speak. But, in addition to this localised *virtual field*, Foucault has the notion of *episteme*, which becomes the 'macro-notion' for this *distributed virtual field of discursive formations and rationalities*. Of *episteme*, Foucault writes:

> The analysis of discursive formations, of positivities, and knowledge in their relations with epistemological figures and with the sciences is what has been called, to distinguish it from other possible forms of the history of the sciences, the analysis of the episteme ... The description of the episteme presents several essential characteristics therefore: *it opens up an inexhaustible field* and can never be closed; its aim is not to reconstitute the system of postulates that governs all the branches of knowledge (connaissance) of a given period, but to cover *an indefinite field of relations*. (Foucault, 1972, p. 211; my emphasis)

This epistemic *field* is similar to the *virtual field* that is crucial to Foucauldian methodology and the encounter with the Bourdieuian notion of *field*. Through these Foucauldian conceptualisations, we can now set up an encounter between these distinct notions of *field*.

The Encounter of Bourdieuian and Foucauldian Thought

Bourdieu clearly states that Foucault lacked the notion of *habitus* in his work on power and that this deficiency limited his understanding of the acceptance of 'gentle violence' (Wacquant, 1993, p. 34). This article concurs with Bourdieu's commentary regarding Foucault's methodology and its lack of

localised measurement. In other words, Bourdieu's relation of *capital* to *habitus* is necessary in representing power. But how would Foucauldian thinking relate to Bourdieu's methodology here, specifically regarding the notion of *fields*?

The empirical sociological mapping of *fields* raises several issues in a Foucauldian encounter that stem from the methods used in Bourdieuian *field analysis*. The mapping of various forms of *capital* (cultural, economic, symbolic) and *habitus*, and Bourdieu's conceptualisation of *fields of power* draw on practices and methods from the scientific *field* in the form of statistics and geometric linearity in various quantitative analyses (Lebaron, 2009). These practices are not 'neutral', but, rather, carry *discursive formations* and threads linking them to a probabilistic and measureable *episteme*, similar to Foucault's (1970) analyses in *The Order of Things*. Here we are perhaps at point zero of the fissure between the two epistemologies and subsequent methodologies, with the Bourdieuian methodology embracing mathematics and statistics and measuring the probability of the empirical real (his MCA method [5]), and the Foucauldian methodology using historical documents and a new way of reading the archive, an immeasurable gaze on historic strata.

Bourdieu's (1988a, 2000) various analyses of academic *fields*, and philosophy in particular, could thus be seen as a way of defending the pariah science of sociology and the methods it uses against the theoretical non-empirical conceptualisation of philosophers. Bourdieu's epistemological work is posited to save sociological empirically constructed objectification.

The encounter this article proposes between the Bourdieuian and Foucauldian notions of *field* thus enacts a two-pronged methodological movement, examining power through an investigation of the *virtual field*, distributed *rationalities* and the *episteme*, as well as the Bourdieuian sociological mapping of the *field*. The reason behind this additional, or extra, layer of *virtual fields* relates to the above dilemma in Bourdieuian methodology: the problem of transference between *fields*. Foucault's conceptualisation of *rationalities* and their genealogy is critical in understanding the elusiveness of power and how it crosses *fields*.

In relation to the problem associated with mathematics and the empirical methods employed by Bourdieu, the Foucauldian notions have another specific role to play in the encounter. Foucault's methodological approach is needed to explore such mathematical and statistical practices in relation to the sociological representation of power in a *historical* approach. Without a Foucauldian gaze, the Bourdieuian ideal of self-objectification (Bourdieu & Wacquant, 1992) becomes problematic.

In summary, Bourdieu's epistemological and methodological marriage to mathematics, and statistics in particular, is suggested here as the main fissure between the two different representations of power. Two lines of questioning are thus required: What is the role of statistics, and under what forms does it manifest and speak truths? In what ways is statistics a representation of a certain kind of power? Hacking (1990, 1992) has explored this topic, and the current argument is very much in line with his historical research. The problem of mathematics and power is linked, however, to the problem of representation, an event in the subfield of physics in 1927 and the shifts in an *episteme*. The central concern regarding the problem of representing power in the social world thus becomes a problem of mathematics and specific *rationalities* from the scientific *field*: Why do mathematics and calculus always appear when we want to say something about the real and material, and why is this specific form of representation so prevalent in the contemporary educational *field*? Are mathematics and calculus not a specific representation of power originating from the scientific *field*? In this light, Callewaert's critique of Foucault takes on a different meaning:

> like Foucault, exposed to the danger of promoting the devastating trend in the social sciences today, where the everlasting need to tone down science, positivism and behaviorism lead to the absurd idea that social practice is nothing but free construction of meaning. (Callewaert, 2006, p. 96)

In other words, Foucault's approach and representation of power are considered from the Bourdieuian point of view as a relativistic free construction of meaning, but here proposed as a necessary element in the self-objectification of the Bourdieuian sociological representation of power.

Following this encounter and explanation of a specific aspect of the two-pronged methodology (*fields* and *rationalities*), and how, in the same movement, Foucault and Bourdieu

supplement and self-objectify/destabilise each other's methodologies and epistemologies, the article turns to the event and further explores the rationale behind the encounter.

Figure 2. The Quantum Cat.

The 1927 Solvay Conference: a historical event in a subfield of physics

The fifth Solvay Conference, in 1927, on electrons and photons has been established in myth and discourse as the triumph of the Bohr–Heisenberg faction over the Einstein–Schrödinger faction, thus contributing to settling the Bohr–Einstein debate on the quantum:

> After 1927, the Copenhagen interpretation became firmly established. Rival views were marginalized, in particular those represented by de Broglie, Schrödinger and Einstein, even though these scientists were responsible for many of the major developments in quantum physics itself. (This marginalization is apparent in most historical accounts written throughout the twentieth century.) (Bacciagaluppi & Valentini, 2009, p. viii)

At the Solvay Conference, the Copenhagen interpretation [6] 'won' through a special form of rhetoric posited by the Bohr faction. Before further exploring the justification of the methodological encounter of Bourdieuian and Foucauldian methodology and epistemology with regard to the Solvay event, the arguments and academic controversy are presented in layman's terms.

The Bohr–Heisenberg faction proposed the argument that classical Newtonian physics and mechanics were not applicable at the quantum level, and quantum mechanics needed to be built on a new foundation, or principle. Heisenberg and Born wrote in their proceedings:

> Quantum mechanics tries to introduce the new concepts through a precise analysis of what is 'observable in principle'. In fact, this does not mean setting up the principle that a sharp division between 'observable' and 'unobservable' quantities is possible and necessary. As soon as a conceptual scheme is given, one can infer from the observations to other facts that are actually not observable directly, and the boundary between 'observable' and 'unobservable' quantities becomes altogether indeterminate. (Bacciagaluppi & Valentini, 2009, p. 407)

This principle of uncertainty, or indeterminism, related to the Copenhagen interpretation was at the core of Bohr's, Heisenberg's and Born's arguments: 'There seems thus to be no empirical argument against accepting fundamental indeterminism for the microcosm' (Bacciagaluppi & Valentini, 2009, p. 408).

This indeterminism was the primary schism between the factions – in other words, a controversy between orthodoxy and newcomers/revolutionary thoughts in the scientific *field*. The final thing that made arguing against Heisenberg and Born especially difficult was their reference to quantum mechanics as a closed system (Bacciagaluppi & Valentini, 2009, p. 408). Introducing domain

specificity versus universalism in physics was another epistemic change in the scientific *field* of physics, and one whose rhetoric and discourse were especially hard to counter.

The Einstein–Schrödinger faction, with Schrödinger as the presenter at Solvay, tried to overcome the difficulties of the quantum cosmos with a wave-like depiction of the electron in a three-dimensional model in space and time – a more classical rendering. As Schrödinger stated:

> Even though all these results, if one so wishes, can be detached from the picture of the fluctuating charges and be represented in a more abstract form, yet they put quite beyond doubt that the picture is tremendously useful for one who has the need for Anschaulichkeit! (Bacciagaluppi & Valentini, 2009, p. 455)

Schrödinger responded to the matrix mechanics (the uncertainty principle) and Bohr's quantum jumps as follows (keeping true to his picture of the wave):

> I consider this view the only one that would make it possible to hold on to 'quantum jumps' in a coherent way. Either all changes in nature are discontinuous or not a single one. The first view may have many attractions; for the time being however, it still poses great difficulties. If one does not wish to be so radical and give up in principle the use of the *time variable* also for the single atomic system, then it is very natural to assume that it is contained hidden also in equation. (Bacciagaluppi & Valentini, 2009, p. 451; original emphasis)

The above arguments could be seen as the articulation of a defence from a classical wing, fighting a radical new course for physics that includes indeterminism. Schrödinger is pointing out that there is no need for such a radical shift as proposed by Bohr and Heisenberg; it could very well be that certain parts of the equation are still hidden.

One could claim that the better physicists or science prevailed at the 1927 Solvay Conference, that they shook hands and everyone walked away from the conference in apparent peace. But this was not the case. The problems were never resolved and the recessive discourse of the old classical objection to the new *episteme* or indeterminate world view in quantum mechanics continued to simmer, revived especially with Schrödinger's (1935) cat paradox [7] and Einstein's various thought experiments. This clash between determinism and indeterminism, between classical representationism and a new probabilistic representationism, is reproduced to a degree in a new manifestation in the encounter between Foucauldian and Bourdieuian methodologies. The controversy regarding quantum representation is transformed and distributed as a *rationality* of representation containing both indeterminism and determinism, and reproduced in other *fields* in academia.

From the Event to a Two-Pronged Movement and Methodology

Understanding an event and how it can transform various other *fields* through *rationalities*, creating a clamour of controversy regarding the representation of power, was well examined by Foucault (1994) and, properly, very much inspired by his reading of Deleuze. Of his notion of *eventalisation*, Foucault said in an interview:

> What do I mean by this term? First of all, a breach of self-evidence. It means making visible a *singularity* at places where there is a temptation to invoke a historical constant, an immediate anthropological trait, or an obviousness that imposes itself uniformly on all. (Foucault, 2000, p. 226; original emphasis)

What Foucault proposes is a redefinition of inevitable historical change and constants in all *fields*. A specific event has the potential to create a *singularity* that ripples through related *fields*. The Solvay Conference in 1927 was such an event, and it created a ripple of indeterminism throughout various other *fields*. In a tribute to the new post-Heisenberg scientific spirit, Bachelard (1984, p. 211) writes: 'The Heisenberg revolution, which has turned physics upside down, has to some extent quieted the conflict between determinism and indeterminism. What Heisenberg did was nothing less than to establish objective indeterminacy in all physical observation' (my emphasis). Bachelard's optimism regarding Heisenberg's new 'objective indeterminancy' is evident; this optimism must, though, have been somewhat quelled due to Schrödinger and Einstein's refusal in 1936 to accept

Heisenberg's objective indeterminacy. The *field* of physics has, in other words, never overcome the Schrödinger–Heisenberg controversy regarding the representation of the quantum.

This article thus proposes a two-pronged Foucault–Bourdieu movement and methodology to represent power, which could be seen as including the *rationalities* of both classical determinism and the new objective indeterminism. In summary, the fifth Solvay Conference was an event which marked and solidified a historical divide in the scientific *field*. The contemporary divide in Foucauldian and Bourdieuian epistemologies and methodologies regarding the representation of power is a transformative reproduction of that historical divide – namely, the divide between determinism and indeterminism. New mathematical approaches were a crucial catalyst of this divide. Building on this discussion, it is possible to consider further the subject of representing power and how the analogy to the quantum helps transfer the two-pronged stance of determinism and indeterminism from the Solvay event to the methodological encounter, thus setting up the framework of a dual approach to representing power. The Bourdieu/Schrödinger and Foucault/Heisenberg encounter thus expands the previous encounter with Bourdieu and Foucault regarding the concept of *field* and *rationalities*.

The Bourdieu–Schrödinger Encounter

In the analogy to the Schrödinger–Heisenberg controversy, one could depict Bourdieu's representation of power as akin to Schrödinger's wave model and multidimensional image, as an empirically founded probability and objectification against non-empirical philosophical indeterminism. Bourdieu's (1984, 1989) multi-correspondence models and depictions of various fields are built upon a classical understanding of space, time and indexical causality. This classical modelling is the very foundation of the statistical method of multi-correspondence. Lebaron (2009) has explored how crucial statistical methods were to Bourdieu's (1990) work, in which multi-correspondence models were employed to exemplify and conceptualise the power relations in specific *fields*. Akin to Schrödinger's wave mechanics, Bourdieu's models are very useful for depicting and understanding power and the 'charge'/force of power at specific locations in the *field*. In short, Bourdieu's concept of power can illustrate the strength, location and hierarchy of power, with his concepts of *habitus*, *field* and *capital*:

> Scientific capital is a particular kind of symbolic capital, a capital based on knowledge and recognition. It is a power which functions as a form of credit, presupposing the trust or belief of those who undergo because they are disposed (by their training and by the very fact of their belonging to the field) to give credit, belief. The structure of the distribution of capital determines the structure of the field, in other words the relations of force among the scientific agents: possession of a large quantity (and therefore a large share) of capital gives power over the field, and there over agents (relatively) less endowed with capital (and over the price of entry to the field) and governs the distribution of the chances of profit. (Bourdieu, 2004, p. 34)

Although Bourdieu becomes the 'transformed Schrödinger' in this article, it is merely for the sake of explaining his theories' crucial role in the encounter with Foucauldian epistemology and methodology. With his classical reconstructed tools of *habitus*, *capital* and *field*, Bourdieu is perhaps the more indeterminate of the two theorists with regard to the agency and resistance of the subject. Similar, however, to the critique raised against Schrödinger's wave model, there is something that this classical multi-correspondence model cannot conceptualise with regard to the representation of power, and this is where a Heisenbergian–Foucauldian approach becomes useful.

The Foucault–Heisenberg Encounter

Foucault's relational approach to power is, in the analogy proposed in this article, akin to Heisenberg's uncertainty principle and matrix mechanics. Foucault is elusive, especially regarding the social sciences, as to what power is and how it operates. Power is at once a practice, a discourse or, perhaps, in the line with Heisenberg, an entanglement related to the body and the subject (Foucault, 1995). Deleuze (2006) draws a picture of 'The Diagram' as a way to visualise Foucault's view of power – a diagram or relation between the vertical ('The Archive', discourse or archaeological aspect) and the horizontal ('The Map', practice, discourse or genealogical aspect).

Foucault draws heavily on the Nietzschean conceptualisation of power as something that escapes presentation; the moment we attempt to represent it, it transforms itself or, in the Heisenberg analogy, the viewing observer disrupts the microcosm of the atom. What Foucault and Heisenberg capture in their conceptualisation of power and the atom, respectively, are the spread and displacement of power, and the uncertainty of the 'position' of power. One can never, in the methodological sense, be sure as to where power is or that it is necessarily anchored in this or that practice or institution. This uncertainty and displacement transcend *fields* and agents, which means two important things regarding the nature of power and the scientific *field*, encountering the Bourdieuian notion of *field*. First, power displaces, transverses and transforms across *fields*. Second, disruptions in power or relational changes in, for example, the scientific *field* have the ability to affect other related *fields*. The implications of these encounters and their necessary inclusion in a two-pronged movement can be exemplified in outlining an investigation of the educational *field*, with a specific focus on influence from the scientific *field*.

The Methodological Encounter and the Relation between the Educational and Scientific Fields

This article has outlined how and why an encounter between Foucauldian and Bourdieuian epistemology and methodology could be useful in representing power, and how the controversy between Schrödinger and Heisenberg acts as an analogy, and a justification, of a two-pronged methodology incorporating both deterministic and indeterministic methodologies. The encounter presented here is particularly useful for exploring the educational *field* and the influence of other *fields* on it. The educational *field* [8] has certain specific historical conditions due to its overall place in society, which makes it a *field* with very little autonomy that is subject to influence from other *fields* (Boli et al, 1985; Meyer et al, 1992). This argument is in line with contemporary educational research and the problematisation of various influences on the educational *field* (see, for example, Grosvenor et al, 1999; Lawn, 2008; Lawn & Grek, 2012). The educational *field* is depicted as a melting pot of various national and international interests, all historically intent on shaping schooling and education in their own image. The educational *field* and the institutions therein are the starting point, so to speak, of the agents of the various other *fields*. As Bourdieu and Passeron (1990) have shown, this is where economic *capital* and cultural *capital* shape educational choices and trajectories, and the agents' subsequent transitions to other *fields*. It is in the educational *field* that we see educational practices shaping children into the ideal agent/professional in relation to the other *fields*, thus creating the scientist, the judge, the police officer, the democratic citizen, and so forth. The educational *field* is thus, from the perspective of this article, a *field* that is influenced by specific forms of *capital* and *habitus* framing the possibilities for success of the agents, and, simultaneously, a multitude of *rationalities* stemming from other *fields* are shaping the practices and domains of knowledge therein.

If one were to propose an example of this relation between the educational *field* and the scientific *field*, one could examine mathematics and the role it currently plays in both the scientific *field* and the educational *field*, and, as previously explored, in the representation of power (Gingras, 2001). The specific role mathematics assumes in various *fields* is different and transformed according to the inner logics of the *field*, but it is simultaneously a scientific *rationality*, which, like the notion of economic *capital*, has spread through various *fields*. Earlier in the article, mathematics was proposed as the major wedge between the Bourdieuian and Foucauldian representations of power; similarly, the effects of mathematics as a special representation of power are reproduced in a transformed manifestation across *fields*.

How, then, would the methodological encounter examine this relation? Mathematics and its various manifestations (for instance, as data and evidence) would be a specific *rationality* in Foucauldian epistemology, a *rationality* embedded with a power–knowledge structure:

> First, analysis at the level of formalization: it is this history that mathematics never ceases to recount about itself in the process of its own development. What it possesses at a given moment (its domain, its methods, the objects that it defines, the language it employs) is never thrown back into the external field of non-scientificity, but is constantly undergoing redefinition (if only

> as an area that has fallen into disuse or temporary sterility) in the formal structure that mathematics constitutes. (Foucault, 1972, p. 209)

The specific formalisation of mathematics thus acts as an obfuscation of its power–knowledge structure; it carries a specific truth across *virtual fields*. Mathematics similarly becomes a practice of discipline and of cognitive training. Popkewitz (2004a, 2008) in particular examines this problem regarding mathematics in a Foucauldian light.

Mathematics and its various manifestations would, in Bourdieuian epistemology, be a specific symbolic *capital* – a scientific *capital* that can be exchanged in other *fields*. Mathematics originates as scientific *capital* in the scientific *field* but traverses a multitude of *fields*. This specific *capital* is measurable in the agents who possess it and, as seen at the Solvay event, acts as a vehicle or power in accruing other forms of *capital* (winning debates through mathematical arguments, mastering mathematical techniques in statistics and the economy, etc.). The educational *field* has shaped its practices and institutions to set up a situation where mathematics can be transferred from a teacher and learned by a pupil. This particular frame raises problems regarding influences from other *fields*. The issues that this specific conceptualisation of learning produces have been discussed by Biesta (2013) and Popkewitz (2004b). We thus see a concrete example where the two-pronged movement and methodology come into their own: without Bourdieu's conceptualisations of *capital*, *habitus* and *field*, we would not have a methodology to map out and probably measure the various forms of *capital*. This measurement of a *field* of dispositions is a specific way to represent power and is specifically equipped to show the influence of the economy on the various *fields*. But Bourdieu's concept of scientific *capital* cannot account for the very specific way this scientific *capital* traverses fields. Mathematics is, in other words, a form of both *capital* and *rationality*.

Tracing the genealogy of a *rationality* is where Foucauldian methodology comes to the fore. As seen, the above *rationalities* intersect and draw upon each other in a complicated web in the specific *field*. But what is of importance and relevance to the educational *field* is the fact that *rationalities* travel. They take on different shapes according to the specific laws and characteristics of the respective *fields* in which they manifest themselves. The *rationalities* do not literally 'move' from one *field* to the next but, instead, at the moment the *rationality* discursively manifests in a *field*, there is a probability that it is also manifesting itself in other *fields* simultaneously. The concept of entanglement thus helps one understand how power operates: an occurrence in one *field* has the potential for another manifestation in every other *field* related to it, depending on the structural conditions in the respective *fields*. A Foucauldian approach helps one understand the nature and manifestations of those rationalities, which transcends, for example, the way economic *capital* can be weighed and measured in the different *fields* with the logic of the multi-correspondence method. In other words, analysing the scientific *capital* in the scientific *field* is done as if it is a specific form of symbolic *capital*, but, in order to analyse the scientific *rationalities* across *fields*, one has to resort to a Foucauldian genealogical method by tracing discourses. This obviously raises the question of the relation between scientific *capital* and the specific scientific *rationalities* in other fields. This relation is neither causal nor arbitrary, but, to use Heisenberg's nomenclature, a 'matrix mechanic' in the social sphere or, at least, a very complicated entanglement.

In summary, in order to illuminate a scientific *rationality* and practice such as mathematics, one can benefit from using Foucault's methodologies, thereby showing the 'life' and transformation of the *rationality* and its subsequent forms of practice. Additionally, in the same analytic move, one uses Bourdieu's concepts to measure and observe in the educational *field* the role this mathematisation plays in the *habitus* of pupils, teachers and other agents within the institutions of the educational *field*. This article is thus in line with Bachelard (1984) regarding the crucial and wondrous part mathematics plays in the new, post-Heisenberg scientific sprit, but, from the methodological encounters, the representation of power and mathematics is manifested very differently in various *fields*, considerably unlike the force of creation and experimentation that is within the subfield of mathematics itself.

In the educational *field*, mathematics becomes a disciplinary practice to be learned and manifested across various institutional levels, as well as a *rationality* of measurement and a specific form of governance. In the role of a *rationality* of measurement, mathematics becomes a tool to measure attainments, school performance, one's probability of success, and barriers to reaching other levels of the educational system and its hierarchy (Grek, 2009). Mathematics thus takes on

many different roles within the educational *field*, but common to them all is the indirect connection with power and the very specific shaping of subjects (Popkewitz, 2004a). In other words, the new role of mathematical formalism, which gave birth to the uncertainty principle, has turned into a very different beast in other *fields*; it is as if determinism escaped from the *subfield* of mathematics and physics only to have its negativity reinforced in different *fields*.

A Methodological Stance between the Cat and the Principle

This article has attempted to enunciate a two-pronged methodological movement to represent power. This approach takes place in the very fissure of an epistemological divide, using Foucault against Bourdieu and vice versa, and setting up an encounter between theoreticist theory and empiricist methodology (Bourdieu, 1988b).

But how do we account for the validity of the encounter between two supposedly conflicted theoreticists? For a two-pronged methodology would necessarily imply more work for the educational researcher. To learn from Heisenberg, when we measure one thing, there is always another thing we can now see less clearly, another truth becoming blurry while we sharpen our gaze on our chosen object or subject. It has been argued here that the educational researcher needs an epistemology and methodology of determinism and empiricist methods: a degree of measurement of different forms of *capital* and socio-economic status, concrete observations of behaviour and a notion of causality in the educational *field*. If this epistemology and practice of determinism is not included in our methodology, it will be too easily dismissed by the way the disciplines work within the academic and economic *fields* ('Where is your validity?' 'Is that evident?' etc.). This kind of deterministic discourse is 'right', up to a certain point. This article thus agrees with Bourdieu's (2000) reservations about philosophy and Foucault's method (see also Wacquant, 1993). But, in the same movement, the educational researcher needs an epistemology of indeterminism, of uncertainty – a way to methodologically trace something that is not playing by the rules set forth by causality and determinism. Foucault's stance supplies such a perspective. Researchers in the educational *field* must continue to stand between Schrödinger's cat of deterministic objection towards indeterminism and Heisenberg's principle of indeterminism, to represent the way power operates and frames subjects in various *fields*. To do otherwise will leave us with half-truths and only chasing shadows in a dimly lit *field*. Representing power thus becomes a principle of the cat advocating a stance of opposites, constantly decentring one representation of power with the other in a singular movement of research.

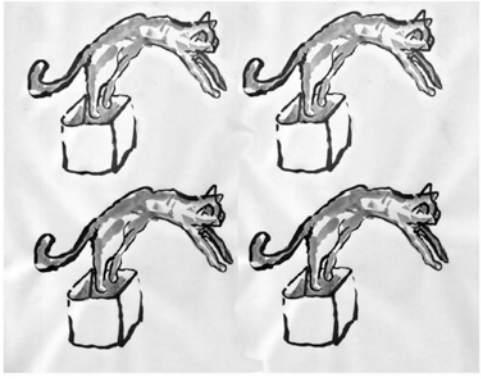

Figure 3. Escaping the box.

Notes

[1] When I talk about 'representation of power' in this article, it is in the sense of Bourdieu's and Foucault's different representations regarding the nature of power. Both theorists note that power is

somewhat unrepresentable, but their representation in their various writings cited in this article is their 'representation of power'.

[2] The scientific *field* is the *field* of the natural sciences (including mathematics) and their various institutions and agents. Of course, it very much overlaps and is entangled with the academic *field*.

[3] This crude categorisation is not to put either Foucault or Bourdieu into boxes, but to emphasise that the controversy regarding their differences about power can also be considered a larger controversy regarding the representation of power.

[4] Bourdieu's and Foucault's concrete concepts are in italics.

[5] Multiple correspondence analysis (MCA) is a specific way of doing statistical cluster analysis and it was crucial for Bourdieu's axis of cultural and economic capital, and the inherent grouping in his data set (Le Roux & Rouanet, 2010).

[6] The 'Copenhagen interpretation' is a term that was first used by Heisenberg in 1930 to denote the collaborative work between Heisenberg, Bohr and others in the 1920s, and it was very much described as a certain kind of 'spirit' (*Geist*) among the researchers. The Copenhagen interpretation is seen in this article as the spirit of indeterminism in the quantum world and a revolution of the classical *episteme* in physics. The uncertainty principle is part of the Copenhagen interpretation.

[7] Schrödinger's cat paradox is a thought experiment developed as a critique against the Copenhagen interpretation (Bohr–Heisenberg) and the uncertainty principle (Schrödinger, 1935). In short, Schrödinger's objection was how can a cat simultaneously be alive and dead inside a special closed box, which represented the quantum?

[8] The educational *field* is a somewhat special, one could say entangled, field in terms of the great interest that agents and institutions from other fields have in it. In the encounter which follows, the notion of *field* is the Bourdieuian notion of *field* layered with the Foucauldian *virtual field* presented previously. Field subsequently denoted in italics is this special methodological construct.

References

Bacciagaluppi, G. & Valentini, A. (2009) *Quantum Theory at the Crossroads*. Cambridge: Cambridge University Press. http://dx.doi.org/10.1017/CBO9781139194983

Bachelard, G. (1984) *The New Scientific Spirit*, trans. A. Goldhammer. Boston: Beacon Press.

Biesta, G. (2013) Interrupting the Politics of Learning, *Power and Education*, 5(1), 4-15. http://dx.doi.org/10.2304/power.2013.5.1.4

Boli, J., Ramirez, F.O. & Meyer, J.W. (1985) Explaining the Origins and Expansion of Mass Education, *Comparative Education Review*, 29(2), 145-170. http://dx.doi.org/10.1086/446504

Bourdieu, P. (1977) *Outline of a Theory of Practice*. Cambridge: Cambridge University Press. http://dx.doi.org/10.1017/CBO9780511812507

Bourdieu, P. (1984) *Distinction: a social critique of the judgement of taste*. Cambridge, MA: Harvard University Press.

Bourdieu, P. (1988a) *Homo Academicus*. Cambridge: Polity Press.

Bourdieu, P. (1988b) Vive la crise! *Theory and Society*, 17(5), 773-787. http://dx.doi.org/10.1007/BF00162619

Bourdieu, P. (1989) Social Space and Symbolic Power, *Sociological Theory*, 7(1), 14-25. http://dx.doi.org/10.2307/202060

Bourdieu, P. (1990) *In Other Words: essays towards a reflexive sociology*. Stanford, CA: Stanford University Press.

Bourdieu, P. (1998) *The State Nobility: elite schools in the field of power*. Stanford, CA: Stanford University Press.

Bourdieu, P. (2000) *Pascalian Meditations*. Stanford, CA: Stanford University Press.

Bourdieu, P. (2004) *Science of Science and Reflexivity*. Cambridge: Polity Press.

Bourdieu, P., Chamboredon, J.-C., Passeron, J.C. & Krais, B. (1991) *The Craft of Sociology: epistemological preliminaries*. Berlin: Walter de Gruyter. http://dx.doi.org/10.1515/9783110856460

Bourdieu, P. & Passeron, J.C. (1990) *Reproduction in Education, Society and Culture*. Cambridge: Sage.

Bourdieu, P. & Wacquant, L.J.D. (1992) *An Invitation to Reflexive Sociology*. Chicago: University of Chicago Press.

Callewaert, S. (2006) Bourdieu, Critic of Foucault: the case of empirical social science against double-game-philosophy, *Theory, Culture and Society*, 23(6), 73-98. http://dx.doi.org/10.1177/0263276406069776

Canguilhem, G. (1989) *The Normal and the Pathological*. New York: Zone Books.

Deleuze, G. (1994) *Difference and Repetition*. London: Continuum.

Deleuze, G. (2006) *Foucault*, trans. S. Hand. London: Athlone Press.

Foucault, M. (1970) *The Order of Things: an archaeology of the human sciences*, 2nd edn. New York: Routledge.

Foucault, M. (1972) *Archaeology of Knowledge*, trans. A.M.S. Smith. London: Routledge.

Foucault, M. (1994) *Aesthetics, Method, and Epistemology*, trans. R. Hurley & Others. New York: Penguin.

Foucault, M. (1995) *Discipline and Punish: the birth of the prison*, trans. A. Sheridan. New York: Random House.

Foucault, M. (2000) *Power*, trans. R. Hurley & Others. New York: Penguin.

Foucault, M. (2010) *The Birth of Biopolitics: Lectures at the College de France, 1978-1979 (Lectures at the Collège de France)*, trans. G. Burcell. New York: Palgrave Macmillan.

Gingras, Y. (2001) What Did Mathematics Do to Physics? *History of Science*, 39, 383-416.

Grek, S. (2009) Governing by Numbers: the PISA 'effect' in Europe, *Journal of Education Policy*, 24(1), 23-37. http://dx.doi.org/10.1080/02680930802412669

Grosvenor, I., Lawn, M. & Rousmaniere, K. (1999) *Silences and Images: the social history of the classroom*. New York: Peter Lang.

Habermas, J. (1985) *Der philosophische Diskurs der Moderne: zwölf Vorlesungen*. Cambridge: Cambridge University Press.

Hacking, I. (1990) *The Taming of Chance*. Cambridge: Cambridge University Press.

Hacking, I. (1992) Statistical Language, Statistical Truth, and Statistical Reason: the self-authentification of a style of scientific reasoning, *The Social Dimension of Science*, 3, 130-157.

Lawn, M. (2008) *An Atlantic Crossing? The Work of the International Examination Inquiry, Its Researchers, Methods and Influence*. Oxford: Symposium Books.

Lawn, M. & Grek, S. (2012) *Europeanizing Education: governing a new policy space*. Oxford: Symposium Books.

Lebaron, F. (2009) How Bourdieu 'Quantified' Bourdieu: the geometric modelling of data, in K. Robson & C. Sanders (Eds) *Quantifying Theory: Pierre Bourdieu*, pp. 11-29. London: Springer.

Le Roux, B. & Rouanet, H. (2010) *Multiple Correspondence Analysis*. London: Sage.

Meyer, J.W., Ramirez, F.O. & Soysal, Y.N. (1992) World Expansion of Mass Education, 1870-1980, *Sociology of Education*, 65(2), 128-149. http://dx.doi.org/10.2307/2112679

Popkewitz, T.S. (2004a) The Alchemy of the Mathematics Curriculum: inscriptions and the fabrication of the child, *American Educational Research Journal*, 41(1), 3-34. http://dx.doi.org/10.3102/00028312041001003

Popkewitz, T.S. (2004b) School Subjects, the Politics of Knowledge, and the Projects of Intellectuals in Change, in P. Valero & R. Zevenbergen (Eds) *Researching the Socio-political Dimensions of Mathematics Education: issues of power in theory and methodology*, pp. 251-267. Boston, MA: Kluwer.

Popkewitz, T.S. (2008) *Cosmopolitanism and the Age of School Reform: science, education, and making society by making the child*. New York: Routledge.

Rabinow, P. & Rose, N. (2003) Foucault Today, in P. Rabinow & N. Rose (Eds) *The Essential Foucault (1954-1984)*, pp. vii-xxxv. New York: New Press.

Schrödinger, E. (1935) The Present Status of Quantum Mechanics, *Die Naturwissenschaften*, 23(48), 1-26.

Wacquant, L.J.D. (1993) From Ruling Class to Field of Power: an interview with Pierre Bourdieu on *La noblesse d'État*, *Theory, Culture and Society*, 10(3), 19-44. http://dx.doi.org/10.1177/026327693010003002

Wacquant, L.J.D. (1998) Foreword, in P. Bourdieu, *The State Nobility: elite schools in the field of power*. Stanford, CA: Stanford University Press.

Whitehead, A.N. (2011) *Science and the Modern World*. Cambridge: Cambridge University Press.

LARS BANG is a PhD student in the Institute of Learning and Philosophy at Aalborg University, Denmark. This article is related to the research methodology applied in the Youth-to-Youth Project, an educational bridge-building project with a specific interest in science education. He has a background as a teacher in special education and holds a Master's degree in Education (Psychology). His current research and teaching interests include science education, educational research, history, and the philosophy of science. *Correspondence*: lbj@learning.aau.dk

[3] THE EARTHLY CARNIVALE OF STRUCTURAL VILLAINS

He who has a body capable of a great many things has a mind whose greatest part is eternal

(Spinoza, 1996, p. 178, VP 46)

> Reason is always a region cut out of the irrational - not sheltered from the irrational at all, but a region traversed by the irrational and defined only by a certain type of relation between irrational factors. Underneath all reason lies delirium, drift. Everything is rational in capitalism, except capital or capitalism itself.
>
> (Guattari, 2008, p. 35, Interview with Deleuze and Guattari)

[3,5]´´´´ THE SECOND CARNIVALE OF NONSENSE

The Structural Hero awakes in a noisy Carnivale within the labyrinth. Everywhere people are hollering, debating, drinking and engaging in acts of desire. The hero finds himself lying on the muddy ground surrounded by different wheeled cages containing strange grotesque figures. "The Bearded Lady" says one of the signs on the cages, and within the cage is a bearded rambling man, dressed as a king shouting "everything is Ideology" while stomping carelessly on a Body without Organs. In another cage, which bears the sign "The Tattooed Man", sits an old venerable man smoking a pipe, scribbling in a large book, bearing the name "Slash True". Upon his chest is tattooed a large upside down tree. The Structural Hero explores a multiplicity of different tents and carriages before he finds himself drawn to a shaggy looking wooden building. Within he notices a large round table, where the dark Knights of the Carnivale carouse in great jest. In one end sits the villains of the Flash, the intensive Rogue Gallery: Captain Cold, Mirror Master, Heatwave, Weather Wizard and so forth. In the other end the villains of the Green Lantern sits, the Lanterns of affects. The yellow lantern of fear, the red lanterns of rage, the orange lantern of greed and so forth. The leader of the table, lacking his face and only recognizable by his green hair, grins eerily toward the Structural Hero. The grinning villain is holding a bloody cord in his hand. Looking down the wayward explorer Real'izes that the umbilical cord he was connected to leads through the Villain and directly to an upright casket, standing behind the leader of the dark

Knight's. The casket contains a newborn replica, a simulacrum of the Structural Hero, wearing the face of the Villain. The umbilical shimmers with an intensity bringing the monster to life. The villain laughs mockingly as the Structural Hero in horror runs out of the tent, and the last words he hears from the villain before escaping further into the labyrinth are: "No more let Life divide what Death can join together"

> "Cursed, cursed creator! Why did I live? Why, in that instant, did I not extinguish the spark of existence which you had so wantonly bestowed? I know not; despair had not yet taken possession of me; my feelings were those of rage and revenge. (Shelley, 2003, p. 232)

> What I most detested was Hegelianism and dialectics. My book on Kant's different; I like it, I did it as a book about an enemy that tries to show how his system works, its various cogs--the tribunal of Reason, the legitimate exercise of the faculties (our subjection to these made all the more hypocritical by our being characterized as legislators). *But I suppose the main way I coped with it at the time was to see the history of philosophy as a sort of buggery or (it comes to the same thing) immaculate conception. I saw myself as taking an author from behind and giving him a child that would be his own offspring, yet monstrous.* It was really important for it to be his own child, because the author had to actually say all I had him saying. But the child was bound to be monstrous too, because it resulted from all sorts of shifting, slipping, dislocations, and hidden emissions that I really enjoyed. (Deleuze, 1995, p. 6, my emphasis)

[5,8]´´´´ THE STRUCTURAL VILLAIN - A SELF-ACCOUNT OF THEORETICAL PATHS NOT TAKEN

A hero is defined by his enemies. A Structural Hero is defined by his Structural Villains. When choosing theories, creating lines of Thought, writing, there is always a Joker in the room.

> We thirsted for lightning and action, we stayed as far away as possible from the happiness of weaklings, from 'resignation' . . . There was a storm in our air, the nature that we *are* grew dark - *because we had no path*. Formula for our happiness: a yes, a no, a straight line, a *goal* . . (Nietzsche, 2005, p. 4, original emphasis)

There is always something you say no to. But you don't dwell on it, and let the sad passions overwhelm you, you carry onward but still a shadowy Joker - the no ∫ the question - trails you stealthily.

For Deleuze the villain was Hegel and dialectics, and then a reversal of Kant, Plato and numerous others. The villain, more than the heroes you choose, define you, propels you onward in the writing, arouse you to passionate agitation, enter heated debates, flirt with chaotic methods. The villain pushes you to all these things. If Deleuze hadn't been pushed, felt it necessary to do a buggery of Hegel and others, his authorship would have died from the beginning, passionless, stale and full of rest. The villains are legion, but let's (for the sake of a sensible account) list a few and their adversary role in the research of this thesis.

Bourdieu is the crux of this thesis, the person=x, the theoretical Movement, which displaces the series of Foucault and Deleuze, which would otherwise be too much in conjunction. The Structural Hero could have chosen another path, affirmed Zizek or Althusser as the displacer but somehow they were found wanting for different reasons. Zizek was too shallow, too rhetoric, too slick, popular and smart. Especially his book on Deleuze is a horrible piece of mis/non-reading of Deleuze's oeuvre (Smith, 2005; Zizek, 2012). Zizek was thus put in the void, not as a displacer but as a great negative alongside Hegel, of whom he is a mouthpiece. Chomsky's words, and thus an empiricist critique, still rings true, though in a displaced form:

> "You say his (Zizek) work is becoming influential, well I would question that. I think his posturing is becoming influential. Can you tell me what the work is? I can't find it. He's a good actor, he makes things sound exciting but can you find any content? I can't. I would have no interest in having a conversation with him and I suppose the converse is true as well I imagine."[5]

Althusser is a much more complicated non-participant in this thesis. In a sense, the Structural Hero senses Althusser's work and oeuvre behind much of Foucault and Deleuze's writings, though in a different emphasis. It is as if Althusser took ideology to its full extent, from the ground up, and then Deleuze and Foucault affirmed that and moved further. Althusser is mentioned with great care and respect by Deleuze in *How do we recognize structuralism?*(Deleuze, 2004a). Interestingly, Althusser turned to Spinoza in his later work (Althusser, 1976). So there isn't a direct opposition between Althusser and Deleuze as someone often claims, or at least not for this Structural Hero.

Strangely enough, Bourdieu, a founding father of this thesis has the other two players in the thesis as his opposites, as exponents of what Bourdieu calls post-modern theory (Bourdieu, 1990, 2000). In other words, by including Bourdieu in

[5] http://history.genius.com/Noam-chomsky-chomsky-zizek-debate-annotated

the same Movement as Deleuze and Foucault it all comes back to the Principle of the Cat, of willingly setting yourself up to fail, from the very beginning.

8,13]´´´´ BOURDIEU VS. FOUCAULT/DELEUZE - UN-PASCALIAN MEDITATIONS

> The clock's run out, time's up, over, bloah!
> Snap back to reality, Oh there goes gravity
> Oh, there goes Rabbit, he choked
> He's so mad, but he won't give up that easy, no
>
> (Eminem, 2002, Lose Yourself).

Imagine Bourdieu vs. Foucault/Deleuze in a rap battle. Bourdieu would lose. He doesn't master the academic language, the philosophical language, to the extent that they do. Foucault was a TV star of the 70's, a jester, a bon vivant and a true master performer. Foucault's skills on TV are easily seen in his debate with Chomsky, which thus becomes a debate containing Foucault's specific stance against an empiricist stance[6] . Deleuze was the storyteller extraordinaire, capturing audiences with his knowledge and philosophical creativity and strange readings of known philosophers. There is a reason Bourdieu turned from philosophy, embraced sociology and it has to do with the very position philosophy had in France post and pre '68. Pierre Macherey analyzes this specific French philosophy sharply in *Philosophy a lá française* (Macherey, 1998). Bourdieu showed the forms of capital in the academic field in France in his book *Homo Academicus* (Bourdieu, 1988) and thus continuously insisted on the methods and methodologies of sociology in his oeuvre. Bourdieu pointed several times the fallacies of both Foucault and other philosophers as 'overreaching' their claim, overextending their influence (strange perhaps he never mentioned Deleuze specifically…):

> In endless movement, startling and imperturbable, ungraspable, the rootless, free-floating (atopos) philosopher seeks, in accordance with the Nietzschian metaphor of the dance, to escape every localization, every fixed viewpoint of a motionless spectator, every objectivist perspective, claiming to be able to adopt an infinite number of viewpoints on the text to be 'deconstructed', inaccessible as much to the author as to the critic.
>
> Unassailable, always a jump ahead, renouncing transcendence only in appearance, a master of the game of 'catcher caught', especially with the social sciences, which he has absorbed the better to challenge, to 'supersede' and to deny them, he is always confident of challenging the most radical challenges and, if nothing else is left to philosophy, of

[6] Chomsky/Foucault debate: https://www.youtube.com/watch?v=3wfNl2L0Gf8

> bearing witness that no one can better deconstruct philosophy than the philosopher himself.
>
> What characterizes all these alternatives, which are simply the projection into the heaven of 'ideas' of the social divisions of the fields, is that they give the illusion that thought is trapped in a totally arbitrary way in a totally arbitrary dilemma. 'If I have to choose between two evils' said Karl Kraus, 'I choose neither.' (Bourdieu, 2000, pp. 107-108)

This long quote summarizes Bourdieu's gripe with philosophers and the trouble with the practice of philosophy in general as he sees it. It is, in a way, the very stance from Marx's Feuerbach thesis against speculative philosophy:

> Feuerbach, consequently, does not see that the "religious sentiment" is itself a social product, and that the abstract individual which he analyses belongs in reality to a particular form of society. (Marx & Engels, 2010, p. 8, 7th Feuerbach thesis)

Philosophers, in short, forget their own role in the social fields, that Thought is embedded in those very fields, and that perhaps the 'smooth space of Thought' is a utopian construct or only exists in art as Deleuze points out. Thus simplified, perhaps ad absurdum, the aristocratic philosopher thus thinks aristocratically, and the proletariat philosopher vice versa (if such can be found at all). The form of labour of the philosopher belongs to the educated, to the aristocratic parts of a society. Bourdieu's villain here is particularly the notion of 'deconstruction' of escaping gender, race, and ethnicity through a Movement of Thought. It should not be thought as a particular instance of social overdetermination but a specific loathing towards philosophers, and one must not forget that Bourdieu originally was educated as a philosopher. In many ways Bourdieu act as the gravitational pull towards the critique of Marx, which this Structural Hero agree with in one of the Movements invoked. There is though a way of out this misère, a way to push both Deleuze/Foucault through Bourdieu and into new uncharted space. Deleuze's notion of the virtual and the actual may 'actually' pave the way for such a heretical affirmation. What if the conceptualizations, the critical toolbox of Bourdieu: [(Habitus)(Capital)]+Field = Practice (Bourdieu, 1984, p. 95) are 'actual' concepts in the sociological and Deleuzian sense? Flawed and broken since they are trying to measure and gather up, what is really virtual in theory. Bourdieu's accounting of Capital, observation of Habitus will thus always have this gritty, actualized character. Nevertheless isn't Bourdieu's notion of Capital an actualized form of Deleuze and Guattaris concept of deterritorialized flows of smooth capital? (Deleuze & Guattari, 1983). Have Deleuze and Guattari ever sat down and measured Capital in the way Bourdieu and his followers did?

Bourdieu has a utopian belief in Reason, and specifically the logic of Science within the scientific field.

> If there is a truth, it is that truth is a stake in struggles. And this is true in the scientific field itself. But the struggles that take place there have their own logic, which raises them from the infinite play of mirrors of radical perspectivism. The objectification of these struggles, and the model of the correspondence between the space of positions and the space of position-takings which reveals its logic, are the product of an effort armed with instruments of totalization and analysis (such as statistics) and oriented towards objectivity, the ultimate but endlessly retreating horizon of a set of collective practices which we can describe, with Bachelard, as 'a constant effort of desubjectivization'. (Bourdieu, 2000, p. 118)

This perspective towards science and Reason is here seen as necessary, not because it is 'right' or 'the truth' or any such nonsense but because it exactly resembles in a particular way the Villain and the Hero in the same stance. It uses a particular form of statistical objectification (multiple correspondence analysis) to 'actualize' and map the field of positions. This particular mapping is necessary both as a rhetorical strategy, but to include a form of 'sense' in the argument, a way to escape language, which Deleuze and Guattari similarly wrote against (Deleuze & Guattari, 1987). Both Bourdieu and Deleuze thus use mathematics but in different ways. In *Mapping [Capital v.2.0]*, there is an attempt, consistently flawed, to push Bourdieu, to outline a methodology, which tries to capture more, measure more forms of strata. Gabriel Tarde shows, theoretically, how such a methodology can be thought. The debate between Tarde and Durkheim, between Leibnizian sociology and classical sociology[7], thus resonates in this particular way of affirming Bourdieu (or is it really Deleuze and Guattari, which are being affirmed by Bourdieu?). It as if the discussion between Tarde and Durkheim bear reminiscence of the problem regarding Bourdieu vs. Deleuze and Foucault.

In summary Bourdieu is a great shadow, a true archenemy, and a necessary traveling companion for an exploration of genealogy or ontology. Bourdieu assumes the theatrical role as the voice of stupid/cleaver Reason, of drawing attention to gravitas, the real (not the Real) and a specific form of accounting. Calling the philosophers' bluff regarding their statements of the social field.

> Sorry, boys! I'm sooooo changeable! It's a weakness with me, but to be fair to myself, it is my only weakness (McGuigan, 2010, stated by Jim Moriarty in Sherlock Holmes)

> The modem world is one of simulacra. Man did not survive God, nor did the identity of the subject survive that of substance. All identities are only simulated, produced as an optical 'effect' by the more profound

[7] Durkheim/tarde document: http://www.bruno-latour.fr/node/354

> game of difference and repetition. We propose to think difference in itself independently of the forms of representation which reduce it to the Same, and the relation of different to different independently of those forms which make them pass through the negative. (Deleuze, 1994, pp. xvii-xviii)

[13,21]´´´´ THE HALL OF DOORS AND PROBLEMS

> The face forgives the mirror
> The worm forgives the plow
> The questions begs the answer
> Can you forgive me somehow
>
> (Waits, 2002, All The World is Green)

> I believe people can change,
> but only for the worse
>
> (Eminem, 2013b, Evil Twin)

> Never believe that a smooth space
> will suffice to save us.
>
> (Deleuze & Guattari, 1987, p. 500)

[21,34]´´´ AND OLD CAVERN OF BARELY LIT NONSENSE

The Structural Hero enters the holy halls of sacred problems and doors, immediately he is filled with a sense of urgency, a sense of limited time. Everywhere he turns there is a pedestal and a sacred problem shimmers virtually upon it. Looking at the problem changes it, touching it makes it disappear. Beside every pedestal there is a connecting door and wormhole to an assemblage of related things and ideas. Every problem is connected to an infinite surface. The Structural Hero finds himself pulled towards a large pedestal carved in ice, where two symbols rest. The S and the inverted S. Royal Science and minor Science. Superman and Superman-reversed (Bizarro) with Clark Kent as the human mask of illusio. The door beside it connects to an impossible number of passages, many of them underground in the labyrinth but similarly connected to the map and strata above. Upon touching the problematic it invokes a bodily splitting. He is hastily divided, as if by a lightning bolt, into two Structural heroes: 1) A structural-researcher of the actualized and the real. 2) A structural-researcher of the virtual/actual and the history of science and its education. He looks upon his newly split twin, it seems somewhat lesser than what he would think, as if the splitting made him smaller and larger at the same time. There is a rumbling in the hall and suddenly the it starts collapsing into a vortex, a Maelstrom. The two simulacra - Structural Hero` & Structural Hero`` - have to escape quickly before all the problems drag them down into the screaming Maelstrom of intensity.

> Neither the problem nor the question is a subjective determination marking a moment of insufficiency in knowledge. Problematic structure is part of objects themselves, allowing them to be grasped as signs, just as the questioning or problematising instance is a part of knowledge allowing its positivity and its specificity to be grasped in the act of *learning*. (Deleuze, 1994, p. 76)

[34,55]´´ WILL THE REAL PROBLEM PLEASE STAND UP? - A SMOOTH I-ACCOUNT OF PROBLEMS CONNECTED TO THE DISSERTATION

The problematic I tried to investigate is connected to the YtY-Project in a superficial and historical sense.

The machines with which I arrived to the project quickly birthed a necessary splitting taking the researcher in two opposite yet related directions at the same time. Initiating the two-pronged methodology, the double Movement, mentioned in *Between the Cat and the Principle*, made this double movement a necessity, and a kind of time travel the only real possibility. There has thus been 1) an investigation of the structural real, through a specific kind of empirical real investigation, and this dissertation is a methodological account of how such an investigation can be constructed and Thought 2) simultaneously there has been an investigation in genealogy, archaeology and ontology regarding Science, Becoming and Being. There is a relation, a larger/lesser Image of Thought, between the two investigations, an attempt to assemble a French marriage of Ontology, Sociology and Archaeology/Genealogy. but the researcher has only trod the first step on that extensive voyage.

If there is one problematic that connects all the writings, gestures and postures throughout the dissertation as a whole it is the problematic regarding Becoming and Science. How does ‘one’ become a scientist and what role does education play in the structuring of Being and Becomings? It is thus a problem regarding transformation, a metamorphosis from the sheep to the lion.

> HAL: I am putting myself to the fullest possible use, which is all I think that any conscious entity can ever hope to do.(Kubrick, 1968, 2001: A Space Odyssey)

How are scientist produced? It seems an obvious question since the solution is right at hand: “A scientist is produced in and through science education”. But is he/she really constructed ‘there’? Were Niels Bohr, Erwin Schrödinger, Stephen Hawking products of a structured education and training in the sciences? Or were their monstrous genius birthed elsewhere in a place outside or below Education? Do we solve the desire of a higher frequency and quality of scientists through better

Science education? This problem and the sociological 'fact' of the reproduction of cultural capital, especially in the natural sciences, become entwined in strange ways. All those bodies who don't choose an educational trajectory toward Science, who found it wanting for different reasons, can they really be 'persuaded' or are they a manifestation of a problem within Science itself? Perhaps Science and its education is encapsulating all, becoming "Science for all", only to have a larger sum of retention, a bigger sum of bodies from which to choose the "right" ones from: to ultimately confirm that Science is a Noble, elitist pursuit for the few, the mad, the well-educated.

Before returning to the problem of Science and its education (deliberately and structurally creating the above 'problem' by and for itself)let's have a gaze upon the space within Science and its education. It all comes down to a problematic regarding space and Becoming.

[55,89]´´ THE SPACE OF SCIENCE EDUCATION - THE FINAL FRONTIER – [N,N+1]

Every space within Education is a striated controlled space of progress (Deleuze & Guattari, 1987). There is a continuous flow between the striated controlled space of the institutions, classrooms and real structures and the smooth space of Thought.[xxiii] There is a resistance towards striated space, a colonization going both ways. Between the students and the teacher there is an opportunity, a probability, for a 'smooth space of Thought'. This utopian instance is where something revolutionary is related, reconnected and structured. The perceived holy grail of Educational research is thus the quest for the recipe to that smooth space. How do we create/improve/give space to such a practice of 'smooth space' to unfold? And here comes the problem, we can't predict it, no matter how many attempts educational research attempts, it escapes us. The intensity of interest, joy and passion won't let itself become a striated formula. Positive reinforcement will only create a better disciplination within striated space. "Evidence of good Education that works" says the Minotaur: never has a statement rung so hollow, seemed so shallow. In real striated space, the rural lands, the hills, the old fishing and farming communities of Northern Jutland, there has always been smooth space almost romantically existing alongside striated space. A place of learning, whether it was in the small village school, in a fishing boat, in the stables of a farm, in a mechanics machine shop. This smooth space has now been replaced through deterritorializations of capitalism and Science, gone forever like a beautiful faery tale. What is left are large institutions of schools, schools of farming, school of 'fishing', schools of x-learning. Everything has been turned into educational structures. Education used to be an ambulant/minor/nomad science but not anymore. It has been snatched up and deterritorialized by Royal science. Educational researchers are now/have always been assimilated into educational royal scientists.

> There is a type of ambulant scientist whom State scientists are forever fighting or integrating or allying with, even going so far as to propose a minor position for them within the legal system of science and technology.
>
> It is not that the ambulant sciences are more saturated with irrational procedures, with mystery and magic. They only get that way when they fall into abeyance. And the royal sciences, for their part, also surround themselves with much priestliness and magic. *Rather, what becomes apparent in the rivalry between the two models is that the ambulant or nomad sciences do not destine science to take on an autonomous power, or even to have an autonomous development*. They do not have the means for that because they subordinate all their operations to the sensible conditions of intuition and construction—following the flow of matter, drawing and linking up smooth space. (Deleuze & Guattari, 1987, p. 373, my emphasis)

The possibilities of a smooth space within school is still there, but there is a new Movement of flows approaching, a new horrific cybernetic assimilation of smooth space in education into smooth capital.[xxiv] Of creating a practice, a pill, to artificially and cybernetically induce this smooth space, whether it is through Mindfulness, a regimentation of the body, national tests, more exercise and so forth. The smooth space is vanishing and striated space tries desperately to conjure back its necessary missing evil twin. Perhaps we will soon see a new cybernetic form of smooth space, a pure space of information, of measurable data and learning, a space that will exclude bare life.[xxv]

[89,144]´´ BACK TO THE FUTURE - REVISITING THE OUROBOROS

> Agent Smith: Why, Mr. Anderson? Why, why? Why do you do it? Why, why get up? Why keep fighting? Do you believe you're fighting... for something? For more than your survival? Can you tell me what it is? Do you even know? Is it freedom? Or truth? Perhaps peace? Could it be for love? Illusions, Mr. Anderson. Vagaries of perception. Temporary constructs of a feeble human intellect trying desperately to justify an existence that is without meaning or purpose. And all of them as artificial as the Matrix itself, although... only a human mind could invent something as insipid as love. You must be able to see it, Mr. Anderson. You must know it by now. You can't win. It's pointless to keep fighting. Why, Mr. Anderson? Why? Why do you persist?
>
> Neo: Because I choose to. (Wachowskis, 2003, The Matrix Revolutions)

It is in the very monstrous nature of scientific knowledge, of Enlightenment itself, to be all expanding, all including. This has previously been regulated within the scientific field itself, destroying old knowledge, replacing stale concepts with new fresh concepts of Thought and tested them empirically. But in the new 'educational science' the Ouroboros becomes too gluttonous, too fat. In the eagerness to measure the un-measureable, to predict the unpredictable, it grows and grows as if it in a hectic confusion. It tries to overcome the problematic by pure growth. Thus everyone, every student in Northern Jutland, every wayward participant of the YtY Project has to become included, eaten up by the Ouroboros. The most important things to measure are those outside the normal curve of distribution, the anomalies. Thus (educational) Science would be most interested in those who resist it, to obliterate resistance by incorporation (Merton, 1968b) To create Projects to persuade, create interest, make a grand science show and so forth, to get the last fallen reject into the fold. None is more loved than the returned prodigal son returning to the bosom of Science and its education, and the father would go to any length to get him back. Luckily there are always smooth spaces of resistance within projects such as YtY, spaces where you can do something else, something truly interesting and full of joy. You can start creating relations, creating bonds between bodies across the institutions, planting the seed of an alternative way of education, a new way of thinking learning. This space cropped up, unexpectedly within the YtY Project, as an act of creation between the pupils, the mentors and the teachers themselves, improbable and unpredicted. This was only doable because the ones in charge of the striated space, the 'activities of the project' assumed a 'hands off' stance, of not touching, of looking the other way and only posthumously listening to the accounts of the participants. There is thus an opportunity of resisting the multiplication of striated space, of looking away and just letting the pot of bodies, of multiplicities simmer. Smooth spaces open up in education, but only when the eyes are wide shut, and the regulators/developers/evaluators/all the well meaning idle hands are busy doing something else….

> As converter and capturer, the State does not just relativize movement, it reimparts absolute movement. It does not just go from the smooth to the striated, it reconstitutes smooth space; it reimparts smooth in the wake of the striated. It is true that this new nomadism accompanies a worldwide war machine whose organization exceeds the State apparatuses and passes into energy, military-industrial, and multinational complexes. We say this as a reminder that smooth space and the form of exteriority do not have an irresistible revolutionary calling but change meaning drastically depending on the interactions they are part of and the concrete conditions of their exercise or establishment (Deleuze & Guattari, 1987, p. 387)

[144,233]´´ BENDING MY KNEE TO NEW MATERIALISM - A RANT FROM A STRUCTURAL HERO

> The capitalist machine does not run the risk of becoming mad, it is mad from one end to the other and from the beginning, and this is the source of its rationality. Marx's black humor, the source of Capital, is his fascination with such a machine: how it came to be assembled, on what foundation of decoding and deterritorialization; how it works, always more decoded, always more deterritorialized; how its operation grows more relentless with the development of the axiomatic, the combination of the flows; how it produces the terrible single class of gray gentlemen who keep up the machine; how it does not run the risk of dying all alone, but rather of making us die, by provoking to the very end investments of desire that do not even go by way of a deceptive and subjective ideology, and that lead us to cry out to the very end, Long live capital in all its reality, in all its objective dissimulation! Except in ideology, there has never been a humane, liberal, paternal, etc., capitalism. Capitalism is defined by a cruelty having no parallel in the primitive system of cruelty, and by a terror having no parallel in the despotic regime of terror.
>
> (Deleuze & Guattari, 1983, p. 373)

> (…) but as Prometheus, having stolen fire from heaven, begins to build houses and to settle upon the earth, so philosophy, expanded to be the whole world, turns against the world of appearance. The same now with the philosophy of Hegel.
>
> (Marx, 2010, p. 491)

[233,377]´´ IN THE FIRST AND LAST CIRCLE OF NONSENSE

The Structural Hero enters, filled with great humility, the grassy circle of Forces. Here the avatars of Nature and Force, slumbers and stretch their influence out to all things. The largest is a tall shambling tree-thing, with human features: The Swamp Thing of the Living Green, who stands guardian over all living, filled with the absolute necessity of his/its task. Beside him stands the crooked Arcane, a cadaverous ghoul, a villain of the Grey Decay, needed but often over stretching his reach. The last persona in the circle is the naked hero Animal Man, cast into a role

as guardian of The Red, of blood, bones, meat and flows, a master of Becoming and a vigilant ally to the Green. The avatars stand before a red miniature castle. It used to be bigger and bustle with activity but now blue shades are creeping in everywhere in the grassy circle, diminishing its size. The Hero kneels before the castle, and the avatars of force, swears a solemn binding oath of fealty and lays down his weapons. The castle grows a little by his presence and for a short moment he can glimpse the Arch Heir Lark Minx in one of the tiny towers.

[377,610]´´ BEHOLD A 'NEW MATERIALISM' - A REACTIVE RANT OF MINOR CONSEQUENCE

> And behold I shall be a blight upon the land, and everything I touch shall wither and die!
>
> (Geda, 1999, statement by Blight enemy of Future Batman)

> The standpoint of the old materialism is civil society; the standpoint of the new is human society, or social humanity.
>
> (Marx & Engels, 2010, p. 5, 10th Feuerbach thesis)

In the 80's and 90's there was a 'turn to linguistics' in educational research, preempted by the 'linguistic turn' in philosophy from the 60's (and perhaps Rorty's book from 1967 *The linguistic turn: Essays in philosophical method* (Rorty, 1992)) and probably before. Everything was language, became language; and the specific language relativism sprouted freely, encapsulating regimes of Thought.

> In the last decade, we have witnessed a considerable celebration of the collapse of Western metaphysics. Philosophers and literary theorists have persuaded social and political thinkers that they have been working with contaminated concepts, discourses and texts that are rotten with false binarisms, outworn subject and object representations and, worst of all, full with a phallic-physics whose power is now spent. The collapse of Western metaphysics should bring down with it, of course, both capitalism and communism. Thus postmodern celebrants can congratulate themselves upon a doubled criticism which appears to have had an historical effect beyond anything dreamed of by the ancien régime of critical thought and enlightened reason. (O'Neill, 2004, p. 191)

The beginning of this 'turn' is of course arbitrary and created its own counter-movements in discourse, theory and practice. Following this turn came (though not in the teleological sense) a new turn, a right political turn towards a strong urge to objectify, measure and quantify.

It was as if language had been taken to the very end of its particular form Reason, become nonsense, and thus there was only to go back and do sensical ‘stuff’. No other place was this more visible than in education, which had always been a particularly contested field between ‘educational science’, didactics, moral and so forth or between Royal science ∫ Ambulant / minor science. Education has always been a melting pot of many conflicting notions and ideas. As if to counter the right turn towards quantifiable proof, evidence, “Education that works” and similar hollow capitalistic infested stances, there has come a new turn, at least in educational research, towards ontology . The new turn of the ’00 is a turn towards “Everything is now about ontology”, of which this dissertation can be seen as a symptom.

But is the turn ontology new and truly productive? Marx declared a new materialism, Spinoza proposed one as well, Bohr, Heisenberg and others saw that the old materialistic worldview disappeared with the quantum… Isn’t there a danger this ‘turn towards ontology’ obfuscates problems of capitalism, power and the real. Didn’t Deleuze turn to Guattari for a reason? The Structural Villain could see the turn towards ontology as a symptom of something even more horrid, of an escape due to the monstrous, unchangeable reality of capitalism. Couldn’t the desire to investigate, write and focus upon ontology be like Caligula’s orgies, like Nero’s madness just before the burning of Rome? Unable to change the status quo we desire an escape into intensities, becoming and a utopian dream?

There is a reason, this Structural Hero thinks, that Deleuze’s last unfinished work was about Marx ‘The Grandeur of Marx’. Marx is the only philosopher, economist, sociologist and thinker who has connected ontology and the revolutionary stance to the highest degree, whose thinking made worlds topple and bodies tremble. Marx thus become the model to strive for all educational researchers, for all educational utopists. Only Marx overturns capitalism. But sadly Marx has been reduced to ridicule, “come on do you still read Marx, don’t you know communism doesn’t work?” have been spouted towards the hero more times, than he can count.

So, yes, I bend my knee to new materialism, but not the new materialism of Karan Barad and other contemporaries, which are only a shallow reflection of what a new materialism could become. I bow, together with Deleuze’s fallen ghost, before Marx, Spinoza and Nietzsche - none other are yet worthy of a Structural Hero’s loyalty and fealty.

[610,987]´´ THE SLEEP OF REASON PRODUCES MONSTERS

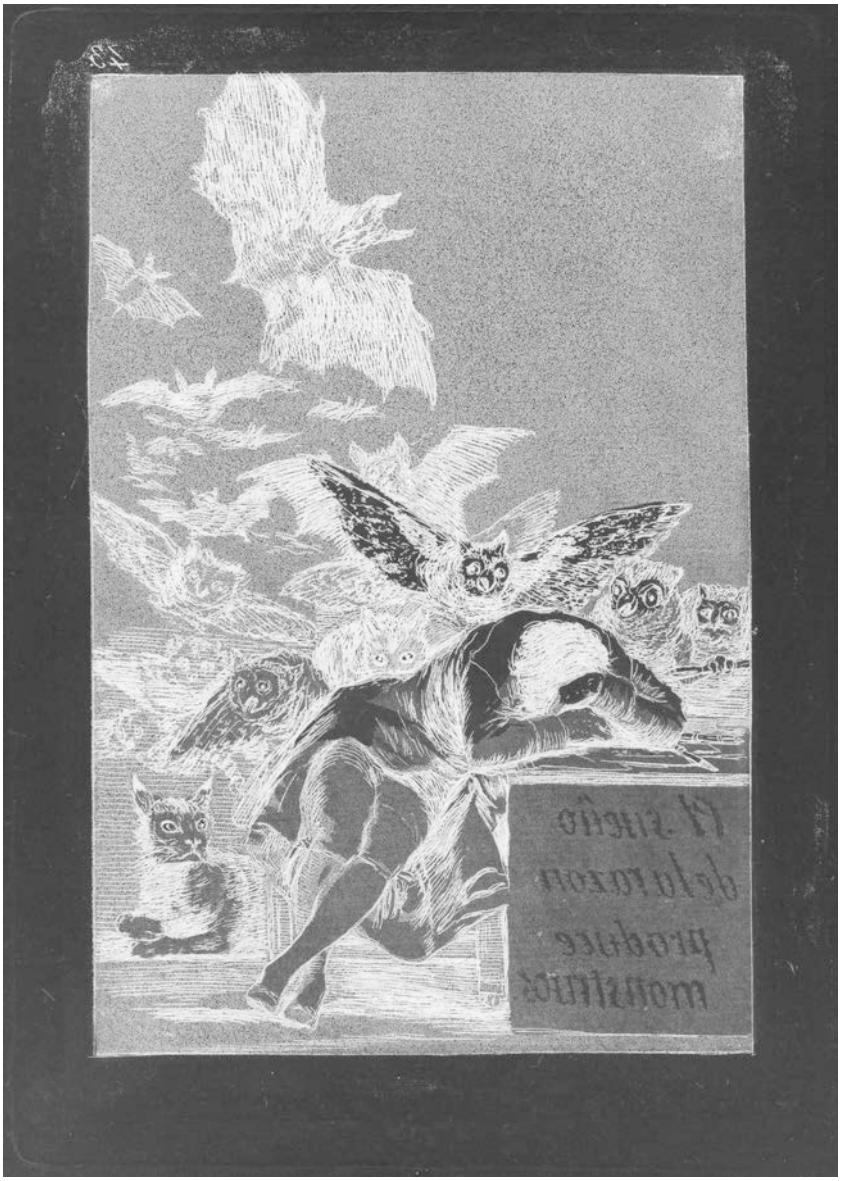

Image: Sleep of Reason produces Monsters, Originally by Goya, Rendered by Christian Bang

[987,1597]´´ IN A SMOOTH PAINTING/MUSIC OF THOUGHT

What induces the sleep of Reason? Is it just that when ‘I’ sleep Reason sleeps, is I = Reason? Neo slept in the Matrix, Alice in Wonderland slept - sleep has been depicted as the great gateway to Unreason, to the productive realm of Dreaming. The monsters are the productive intensive forces of sleep. They wake you up with a feeling of having discovered a great problematic, resolved a pounding desire, Become something else, “made love to Elizabeth Taylor “..

But what if the sleep of Reason could be induced even when we are awake, what if we actively could make Reason go to sleep. There is a circular “why” lurking here. Why make Reason sleep? Is it just simply to produce monsters? Let’s us imagine there are different kinds of Reason in waking life, good Reason and sad Reason. The Reason posited by the fractured ‘I’ is not Spinoza’s Reason, it is a sad Reason scared of the monsters lurking in the unconscious. The ‘fractured I’ tries impotently to remember, reason and understand having barred or forgotten the ‘dissolved Self’, closed of individuation through a bastard con-science of sad Reason. Sad Reason must sleep to release the Becoming-Intensive of the dissolved Self, and only by deliberately putting the Reason of con-science to sleep can that be accomplished. Good and joyful Reason know this, acknowledge and see the necessary stupor, the necessary sleep.

Nietzsche knew how to do it, Artaud knew how to do it, the hero of Gotham City does it still, a Structural Hero and all the inmates of Education must learn to do it.

> Lyrics coming at you at supersonic speed, (JJ Fad)
> Uh, summa lumma dooma lumma you assuming I'm a human
> What I gotta do to get it through to you I'm superhuman
> Innovative and I'm made of rubber, so that anything you say is
> Ricochet in off a me and it'll glue to you
> And I'm devastating more than ever demonstrating
> How to give a motherfuckin' audience a feeling like it's levitating
> Never fading, and I know that haters are forever waiting
> For the day that they can say I fell off, they'll be celebrating
> 'Cause I know the way to get 'em motivated
>
> (Eminem, 2013d, Rap God)

[1597,2585]´´ARTICLE: MAPPING [CAPITAL V.2.0]

Mapping [Capital v.2.0] – an Encounter of Thoughts

Lars Bang
Aalborg University, Denmark

ABSTRACT

This chapter aims at exploring the benefits of a theoretical and methodological encounter between Bourdieu's concepts of capital, Deleuze's line of thought and Marxist activity theory, particularly the Russian strand by Ilyenkov and Leontjev. Bourdieu, Deleuze, and Ilyenkov who share a common denominator in Marx. In a contemporary light, Bourdieu's sociological concepts reflect an effort to readdress issues of class and practice as raised by Marx. I claim that development of Marxist activity theory benefits from such an encounter, especially in educational research. The expanded concept of capital is exemplified through the optic of an educational Danish project. I intend to show how the expanded concept of capital resonates with the theoretical framework of activity theory. I also show how development of Marxist activity theory benefits from the methodological construct of capital. Bourdieuian and Deleuzian perspectives, lead to the construction of a new structural map of events.

UPTAKE IN SCIENCE EDUCATION – A QUESTION OF CAPITAL

A literary reference to Shakespearian drama (Kakkori & Huttunen, 2014) introduces the theme of this chapter, that is, human activity related to notions of *capital*, value, and ownership and descriptions of how they are connected.

This kindness will I show.
Go with me to a notary, seal me there
Your single bond, and, in a merry sport,
If you repay me not on such a day,
In such a place, such sum or sums as are
Expressed in the condition, let the forfeit
Be nominated for an equal pound
Of your fair flesh, to be cut off and taken
In what part of your body pleaseth me.

Shylock, Merchant of Venice

This is 2014 and a Danish administrative region suffers from a structural educational problem. Problems of low uptake into science, technology, engineering, and mathematics (STEM) begins in upper secondary schools (gymnasium/STX). The problems continue as poor uptake into university. The facts and figures of the studied region do not match the desired political goal of uptake in tertiary education. There are specific social problems in neighbouring municipalities regarding parental background and educational mobility (Lange, Johannesen & Henriksen, 2010). A regional council associated with the troubled educational system has funded the Youth-to-Youth Project. The purpose is to bridge transfer from primary school to upper secondary school and from upper secondary school to university studies. The goal of the bridging effort is to provide youths with lacking interest and performance in STEM and tertiary education unlikely, a new *foreground* (Alrø, Skovmose & Valero, 2007) related to information and experiences of studying at upper secondary school and university levels means. To implement this scaffolding project, a network was established between teachers and classes from upper primary school (seventh to eighth grades) to upper secondary school, as was a network between students in upper secondary school and university mentors. The main project idea was that relations between youths 'one step ahead' in the educational

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system have a potential to provide another new insights into what it means to study in upper secondary school and at university. The intent was an attempt at dealing with reproduction in the educational system, especially related to STEM areas, facilitating an educational trajectory. This is still the year 2014 and a structural event, an uneven distribution and positioning of interest, has occurred – but only on the surface of the structures, substructures, and strata of a spatio-temporal location in Denmark: *In such a place, such sum or sums as are. Expressed in the condition, let the forfeit. Be nominated for an equal pound* (Shakespeare, 1623). The relation between current similar processes is obvious.

This chapter aims at outlining how the structural problem in education requires a specific conceptualization of *capital* that rests on Marxism, activity theory, and dialectical materialism. Then we will be able to make sense of and topologically map the problem. This specific methodology has been explored previously in relation to the notions of *field* and *power* through an encounter with Pierre Bourdieu and Michel Foucault (Bang, 2014a). I argue that educational researchers need a double movement and construction of *capital* to capture the various ways capital differentiates and manifests between past, current and future activities. The first part of the movement is the construction of a conceptualization of *capital* which lies close to sociology. Bourdieu's methodology helps educational researchers chart relatively valid and measureable factors in different forms of *capital.* Cultural capital and science capital are especially critical to the mapping of the referred structural problem in education. The second part of the movement is inspired by Gilles Deleuze. A conceptualization of capital related to Deleuze's reading of structuralism leads to the creation of a map of events – combining strata of discourse, thought, and history to Bourdieu's axis of cultural and economical capital. Bourdieu's and Deleuze's methodologies have a common denominator in Marx. My aim is to show how the encounter between giants benefits theoretical and methodological research. I use Marxist activity theory and supply a necessary element of a specific kind of structuralism extracted from Bourdieu and Deleuze. However, before I vivisect the body of educational institutions and study their functions, structures and objectives, which explain the given regional 'defect' and ultimately help create a productive map of events, I turn to the concept of *capital.*

CAPITAL – A CONCEPT BEYOND MONEY

The concept of *capital* was at the centre of Marx's analysis and it lies at the very roots of Marxist thought. Examining the consequences of *capital* during the industrial revolution in England gave birth to *The Capital*. Marx and Engels' (1904) careful structural and economical examination paved the way for a new philosophy and way of thought. It is strange that *capital* has somewhat vanished from contemporary activity theory. Now we have to turn elsewhere to conceptualize it. I will readdress and expand the Marxist concept of *capital* to a concept that can be used for analyzing learning and education. In other words, I bring *capital* to the forefront of research grounded in educational and activity theory.

In the first movement Bourdieu's conceptualizations encounter general approaches to activity theory. It is important to emphasize the specific nature of the encounter between viws and conceptualizations this chapter attempts to construct. The theoretical encounter is an *affirmation of measurement* in the Deleuzian sense. This choice does not pose critique toward Marx, Ilyenkov, Bourdieu or Deleuze. The choice rather suggests a necessary movement and expansion of measurement of *capital* across strata, which again posit various perspectives with different roles and ultimately assisting each other in constructing the necessary map of events. But why do educational researchers, especially researchers oriented towards activity theory and dialectical thought, need the concept of *capital*? The answer is a simple one: they need to concept in order to address and topologically visualize the basic and imbedded social

structural inequality (*class*) hidden in learning. Specifically, a learning theory based on a Marxist theoretical foundation needs expanded concepts of *capital* and *class* to address and frame the social dimensions of teaching and learning. Vygotsky (1997, p. 345) elaborates on the theme, saying: "'that psychology needs its own Das Kapital'. He [Vygotsky] did not want to gather psychological illustrations to the well-known theses of materialistic dialectics, but *to apply these theses as tools which allow us to reform the investigative process from inside* and compared to which other methods of obtaining and organizing knowledge are powerless." Vygotsky and related researchers say the methodological approach of *The Capital* (Marx & Engels, 1904) constitutes the very cornerstone of a dialectical material approach in activity theory. There is a need to develop a notion of *capital* that addresses this aspect of the dialectic. There are no *capital*-free cultural domains or institutions and *capital* is a part of and the background of thought, as well as an analytical tool for describing learning and activity. Capital is conceptualized as a structural element and as such the concept covers a real aspect, an imaginary aspect, and a symbolic aspect operating in response to how we recognize structuralism and what structuralism 'is' (Deleuze, 2004, p. 170-192). These aspects are similarly manifested in various ways in Bourdieu's nomenclature.

Contemporary society differs in several ways from the conditions that people met in early industrial society, the environment which Marx analysed in *The Capital*. The concept of *capital* includes the contingency and temporal singularity of cultural historical development. Today *capital* signifies money, which contains virtual, fluid, imaginary and symbolic qualities. Capital is an abstraction deployed to connect different forms of sedimented labour in the form of material products and knowledge organized in a stratum of distribution. David Harvey (2010) emphasizes earlier problems of 'countering' capitalism and, in a way, the rationale behind the expansion of *capital* outlined in this chapter:

> Previous attempts to create a communist or socialist alternative fatally failed to keep the dialectic between the different activity spheres in motion and also failed to embrace the unpredictabilities and uncertainties in the dialectical movement between the spheres. Capitalism has survived precisely by keeping that dialectical movement going and by embracing the inevitable tensions, including crisis that result. (p. 228-229)

The nature of capitalism is a warped and monstrous form of dialectical movement and educational researchers need to conceptualize and visualize this monstrous aspect of *capital* in late market-oriented capitalism and the very fluid forms of life and behaviour it requires and adopts.

THE FIRST MOVEMENT– BOURDIEU MEETS ILYENKOV

Ilyenkov is a Russian thinker who emphasized the specific relation between science and *capital* in a Marxist perspective. It would be helpful turn to him to obtain a glimpse at how the relations between science and *capital* is structured. The particular relation between science, education, and *capital* is crucial to understanding the aforementioned problematic situation in a region of Denmark. In an elaboration of Hegel, Ilyenkov (1977) highlights the relation between forms of *capital*, which is similar to the conceptualizations proposed by Bourdieu (emphasis by this author):

> Just as accumulated labour concentrated in machines, in the instruments and products of labour functions in the form of capital, in the form of 'self-expanding value', for which the individual capitalist functions as the 'executor', so too scientific knowledge, i.e. the accumulated mental labour of society functions in the form of science, i.e. the same sort of impersonal and featureless anonymous force. [...] He does not think here as such – Knowledge, which has taken root in his head during his education, 'thinks'. (p. 79)

Capital is frozen, or sedimented, labour often appearing in the form of commodities and attributed symbolic value. In its physical or pure economical form capital can mean money, products or commodities. In its *mental form* capital covers forms of knowledge and education. The logic of *capital* is metamorphosed into other areas of human activity, very much above and beyond the field of economics and monetary exchange value. This does not

mean, though, in Ilyenkov's or Marx's sense, that an investigation of the forms of *capital* must solely be in 'general terms', just because the particular historic investigation of specific forms of *capital* is both general and particular. The 'nature' of capital is measureable, and even as capital differentiates and shifts form the quality of a quantifiable element remains, capital escapes social science methods of measurement. This appreciation of the concept is very much akin to Gabriel Tarde's description and expansion of what one needs to measure beyond simple wealth, the classical way of measuring capital (Latour & Lepinay, 2009; Tarde, 1902). Emphasis on the above dimensions and aspects of capital suggests a particular role for producing social science knowledge. It relates to the role that *capital* plays as a special form of 'accumulated mental labour' and 'impersonal and featureless anonymous force' Ilyenkov (1977, p. 79). Capital, practice, and similar notions are general abstractions indeed and according to Ilyenkov (ibid., p. 117), for them to make sense if regarded from a cultural historical perspective, there should be a general and a particular form of expression, saying: "The essence of human nature in general can only be brought through a scientific, critical analysis of the 'whole ensemble', of man's social and historical relations to man, through concrete investigation and understanding of the patterns with which the process of the birth and evolution both of human society as a whole and of the separate individual has taken place and is taking place." The quote shows how activity theory and Ilyenkov are in line with Bourdieu's conceptualizations and methods. When Ilyenkov mentions 'The essence of human nature' he remains safely positioned in a theoretical setting dominated by a dialectical 'whole ensemble' perspective rather than essentialism. In the context of this quote, Bourdieu constructed sociological concepts in order to be able to explore particular and general levels of investigation, preferably concrete sociological analyses of sedimented labour or commodities in physical and mental form. Bourdieu's (1986) overall conceptualization of capital is similar to that of Ilyenkov and Marx.

> Capital is accumulated labor (in its materialized, 'incorporated' or embodied form) which, when appropriated on a private, i.e. exclusive, basis by agents or groups of agents, enables them to appropriate social energy in the form of reified or living labor. It is a *vis insita*, a force inscribed in objective or subjective structures, but it is also a *lex insita,* a principle underlying the immanent regularities of the social world. (p. 1)

Capital as a 'force inscribed in objective or subjective structures' and 'principle underlying the immanent regularities of the social world' is very much definitions of the role the concept takes on in contemporary institutions. Only through analysis of capital in its *expanded form* can one understand the social world. Bourdieu (ibid., p. 1) says "It is in fact impossible to account for the structure and functioning of the social world unless one reintroduces capital in all its forms and not solely in the one form recognized by economic theory". To summarize the contents of this section, the object of activity theory is mediated in thought and as a tool, but in the same dialectical movement the object of activity is a product of labour and ultimately a form of *capital*. To forget the *capital* inherent in the object of thought and activity and that thought *ipso facto* is a product of mental labour and *capital* subsequent practices related to this *capital* would, in other words, be to forget the lesson that Marx and his dialectical movement teach.

VIVISECTING CLASS AND CAPITAL

In order to properly reintroduce *capital* to contemporary activity theory, one needs in a first movement to turn to Bourdieu's reflexive sociology and his version of structuralism, which precisely reintroduced *capital* in various forms of analyses into society. Bourdieu (1984, p. 95) developed different concepts in which the following relation takes centre stage: [(Habitus)(Capital)] + Field = Practice. The relation in brackets between *habitus* and *capital* contains a crucial dialectic dimension and facilitates attempts at bridging notions of society to

mind and overcome various dualistic dichotomies regarding subject and object, man and society and so forth. Bourdieu (ibid.) descibers habitus.

> The habitus is both the generative principle of objectively classifiable judgements and the system of classification (*principium divisionis*) of these practices. It is in the relationship between the two capacities which define the habitus, the capacity to produce classifiable practices and works, and the capacity to differentiate and appreciate these practices and products (taste), that the represented social world i.e., the space of lifestyles, is constituted. (p. 170).

Bourdieu (1984, p. 172) describes the crucial dialectic between capital and habitus as: "The dialectic of conditions and habitus is the basis of an alchemy which transforms the distribution of capital, the balance-sheet of a power relation, into a system of perceived differences, distinctive properties, that is, a distribution of symbolic capital, legitimate capital, whose objective truth is misrecognized." Bourdieu's concepts of habitus/capital is where the premise of Marxist activity theory is most vibrant and I will in the following show how Vygotsky's notion of double-stimulus and mediation is visible in Bourdieu's sociological notion of habitus. Bourdieu's (1977, p.72) overall theory of practice describes a way: "... to construct the theory of practice, or, more precisely, the theory of the mode of generation of practices, which is the precondition for establishing an experimental science of the dialectic of the internalization of externality and the externalization of internality, or, more simply, of incorporation and objectification." Isn't the dialectic of 'the internalization of externality and the externalization of internality' precisely what Vygotsky investigated in his research regarding double-stimuli? Bourdieu (1977, p. 79) emphasizes the overarching role mediation plays in his concept of habitus:"The habitus is the universalizing mediation which causes an individual agent's practices, without either explicit reason or signifying intent, to be none the less "sensible" and "reasonable". Furthermore Bourdieu (ibid.) highlights habitus as an acquired system akin to the role systems of activity plays in activity theory.

> Through the habitus, the structure which has produced it governs practice, not by the processes of a mechanical determinism, but through the mediation of the orientations and limits it assigns to the habitus's operations of invention. As an acquired system of generative schemes objectively adjusted to the particular conditions in which it is constituted, the habitus engenders all the thoughts, all the perceptions, and all the actions consistent with those conditions, and no others. (p. 95)

In other words there seems is a fertile ground for an encounter between Bourdieu's conceptualizations and research and research in activity theory. Bourdieu's conceptualizations are inspired by anthropology and traditional sociology, especially the works of Weber and Durkheim, but contrary to theirs Bourdieu's concepts are developed with a dialectical and Marxist orientation. Therefore it would seem productive to set up an encounter with Bourdieu to see how his conceptualizations resonate with the Marxist premise of activity theory as expressed in the Feuerbach theses (Marx & Engels, 1978, p. 143-145). Bourdieu (1990, p. 49) wanted to escape from being called a Marxist sociologist and similar labels, saying about affinity with Marxist ideology: "There may be impassable philosophies, but there is no impassable science. By definition, science is there to be surpassed. And since Marx went to such lengths to claim the title of scientist, the only fitting homage to pay him is to use what he did, and what others have done with what he did, so as to surpass what he thought he did." Bourdieu draws attention to mediations at a 'macro' or class structural level between man, physical objects and activity. His structural macro-perspective is often neglected as a fundamental background for any kind of 'micro' activity. Bourdieu positions himself at the same structural class level as Gramsci and Marx, but with an additional set of conceptualizations devised to explain interactions between individual and society. Another ambition is to show how practices change and form parts of belonging to a particular place in the social field.

Contemporary activity theory research often focuses on micro perspectives of how learning takes place in various settings and how learning begets various practices,

unfortunately often forgetting the Marxist heritage of activity theory (Roth, 2004). Activity theory is more than a theory of learning. It is an attempt at dialectically understanding the relation between subject and object, man and culture, and other abstract but fundamental dichotomies combined with practical considerations. There is a philosophical line, or thread of thought, going from Spinoza to Marx and, further on, from Marx to Vygotsky and Leontjev (Ilyenkov, 1977). Bourdieu brings the latter line of thought into his reflexive sociology and constructs concepts that shed new light on the relation between man and objects and showing how they structure class and practice. In this capacity, Bourdieu revitalizes Marx's concept of *class and capital,* since he brings the dichotomy to the forefront through empirical analyses. Bourdieu's relations between key concepts of *capital*, *habitus*, *field,* and *practice* emphasize why any understanding of practice is interdependent of a complementary understanding of *capital*. Capital must in a first movement combine with notions of *habitus* or *field.* I focus on the relation between a specific form of *capital* and specific forms of practice, reflecting how Bourdieu's concept supplements the current framework of activity theory. Though Bourdieu's conceptualization of *capital* is an abstraction and suited for sociological analyses, the argument is that concrete activity-theoretical analyses of learning suffer from lack of insights into the Marxist inheritance. They would also suffer from lack of insights into the significance (analytical power) of Bourdieu's additional strata or theoretical fields.

ON CAPITAL AND SCIENCE

Akin to Francis Bacon's (2010) famous premise that knowledge is power, one should recognize that knowledge becomes a form of *capital* if applied to conditions and operations in the social field. Just like wealth, knowledge is a measureable entity. Bourdieu proposes three forms of *capital*: 1) economic *capital,* 2) cultural *capital* and 3) social (symbolic) *capital*. These forms of capital are, of course, interrelated and Bourdieu's (1986) notion of transubstantiation between various forms stressing that economic *capital* is the primary form. The other general aspects of a structural element – the real, the imaginary, and the symbolic – are found in all three forms of capital, such that symbolic capital in Bourdieu's sense is not purely social/symbolic. The differentiated forms of *capital* are akin to Ilyenkov's conceptualizations, since they are both general and particular at the same time and always a product of some kind of labour activity. There is an intricate relationship between these forms of capital and only through a combination of micro and macro studies, observations of practice and analyses of the particular institutions can we understand the workings of forms of capital and the specific forms in which they manifest themselves, or are actualized, in the field.

As emphasized in the Ilyenkov quote above, a very particular relationship exists between *capital* and science. Especially in what (Zizek, 2012) terms *late capitalism* there is a crucial relation between economic and cultural *capital* and science. Others have termed relations between economic *capital* and science/academia a new type of post-academic science (Ziman, 1995; 1996). Bourdieu uses three *fields* to examine education, academia and science. He describes them as educational *field,* academic *field* and scientific *field* (Bourdieu, 1988; 1998; 2004; Bourdieu & Passeron, 1990). An alternative way of defining them would be by use of terms of an overall field (like education) and various related subfields. It is important to note the Marxist premise of the notion of *field* – every *field* is a *field* of struggle (Bourdieu, 1984). The notion of strata is used here to describe the different structural layers in the field, a particular notion and use inspired by Deleuze's (1986; 2004) reading of Foucault and of the work with Guattari (1987).

In the educational *field,* knowledge of science is a specific form of cultural *capital*. If you have knowledge, aptitude and skill in science, you are likely to score high in tests and

other forms of assessment and examination. This knowledge is partly reproduced, handed down or inherited. In other words, if you come from an educated family, chances are that the length of your parents' bookshelf influences how easily you learn science at school. This general mode of reproduction or inheritance is a well established fact in sociology (Archer et al., 2012; Bourdieu & Passeron, 1990; Osborne & Dillon, 2008). Cultural *capital* is, however, more, than accumulated knowledge and it is interdependent of *habitus* to enact this specific form of *capital.* It is through the concept of *habitus* or "sense of the game" that the agent exchanges his or her cultural capital to academic recognition and various positions, or grades in the field. Without *habitus* institutions and agents in the educational field will not recognize the actual form of behaviour or *capital* as legitimate. The dialectic between *habitus* and *capital,* between *sense* and *structure,* is obvious in Bourdieu's (2004, p. 35) terminology in outlining the role played by proponents of the scientific field: "The specificity of the scientific field is partly due to the fact that the quantity of accumulated history is especially great, owing in particular to the 'conservation' of its achievements in a particularly economical form, with for example organization into principles and formulae or in the form of a slowly accumulated stock of calibrated actions and routinized skills."

To explore this specific field and its influence on the field of upper secondary education, one needs a concept of *capital* expanded beyond the scientific *capital.* Bourdieu (2004, p. 55) says: "Scientific capital functions as a symbolic capital of recognition that is primarily, sometimes exclusively, valid within the limits of the field (although it can be converted into other kinds of capital, economic capital in particular)." What is not emphasized in this conceptualization is transference of *capital* from other *fields into* the scientific *field,* especially regarding knowledge. In order to explore the mentioned regional problem in Danish education, the relation between cultural capital and scientific capital needs to be enunciated.

To explore scientific practices and knowledge in upper secondary school and the aforementioned problem regarding uptake into STEM areas and into the educational field in general, it would seem advantageous to conceptualize a specific form of scientific *capital* as a subform of cultural *capital divided into* light/minor scientific *capital* compared to the proper scientific *field* and scientific *habitus.* This latter concept was previously dubbed *Homo Empiricus* (Bang, 2014b). The last critical conceptualization stems from the Bourdieuian notion of *field* and how the scientific *field* called proper science at universities influences the educational *field.* This latter field specifically relates to the upper secondary *subfield,* i.e. gymnasiums.

Specific scientific *capital* and subsequent *habitus* is produced and exchanged in particular educational institutions in the educational *field* and problems regarding poor uptake in a specific region in Denmark closely relates to scientific *capital* and *habitus*. This institutional manifestation and the forms of *capital* and *habitus* therein materialize as 'reflection' or perhaps a light version of true scientific institutions in the educational field. The scientific *capital* and *habitus* in the upper secondary subfield of education are produced with the goal of transference into academia and university. The accumulation, distribution, and production of scientific *capital* and *habitus* undergo transference to other institutions and related subfields in the educational *field.* This transference has critical implications for reproduction and the educational trajectory in the educational *field,* as shown in Bourdieu (1998) and Bourdieu and Passeron (1990). In the following text I emphasize cultural *capital* (science *capital*) and *habitus* related to a specific type of institution (gymnasium in Denmark) in the educational field and related to a specific subject matter and practice (science). But, first, the relationship between *capital*, *habitus,* and the traditional activity-theoretical concept of learning must be demarcated.

DIFFERENTIATION OF CULTURAL CAPITAL

Bourdieu (1986) proposes that cultural *capital* covers an embodied state, an objectified state, and an institutionalized state. These states are, in this conceptualization, all states of the real. The three states are important additions and not a direct break to the traditional learning focus of activity theory. Bourdieu (1986, p. 3) says: 'This starting point implies a break with the presuppositions inherent both in the commonsense view, which sees academic success or failure as an effect of natural aptitudes, and in human capital theories'. Cultural capital is actualized in all three states and a study of learning, sedimented labour in the form of knowledge, traverses all three states. A study of learning is the study of a particular cultural *capital* enacted through a particular class *habitus* with a specific temporality and spatiality, that is, a localized position in the stratum. To solely focus on aspects of learning in the traditional sense disavows learning as a neutral process. Therefore one should always consider it enmeshed in a dialectic of specific cultural structures (an assemblage) and their relative localization in time and space in the stratum – often reproducing the same distribution. Learning is not purely the domain of psychology or pedagogy but should, in the same methodological movement, be analysed from the perspective of sociology.

Returning to the problem regarding uptake into the natural sciences in the gymnasium in a Danish region, the above considerations need to be taken into account if one were to propose a dialectical material approach to studying the problem, particularly one oriented towards activity and practice. One could falsely propose that the problem is merely related to specificly *learning* in the natural sciences and that this is why the students are not interested or motivated to choose science as a career or educational trajectory. Then the solution would be to develop teaching practices and adopt an overall focus on the micro situation of teaching and learning and interest/motivation in the sciences. With such a demarcation the researcher overlooks structural circumstances, localization and distribution of the strata and conditions inherent in the acquisition of cultural *capital*. The choice of career in science should be carefully examined regarding learning conditions within the classroom/laboratory and similar micro-settings of specific practices (Latour & Woolgar, 1986; Roth & Lee, 2004). These practices will have tell-tale-signs of manifested *habitus* and forms of *capital,* thereby grounding Bourdieu's macro conceptualizations regarding class and practice.

Keeping in mind the lessons of Marx, Ilyenkov, and Bourdieu, in the same investigation it is, however, necessary to examine a *general structural view*. In this general view, cultural *capital* is a product of family/class conditions or the lay of the land and spatial temporality surrounding the gymnasium. A study of learning and unequal distribution of opportunities requires a socioeconomic analysis coupled with an analysis of cultural *capital* akin to those exemplified by Bourdieu (1984; 1998) and Bourdieu and Passeron (1990). In summary, an overall analysis of cultural capital contains at least two specific perspectives: one perspective including analysis of concrete learning practices in the classroom, manifested as cultural *capital* and *habitus*. Analysis should also cover a perspective for examining the structures surrounding the institution or family or similar larger structures, that is, an assemblage of various manifested forms of *capital, habitus* and *practices*. The following shows the second movement and how the above conceptualizations and movement between Bourdieu and Ilyenkov translates to a methodology of mapping events, which outlines the investigation of the problem regarding uptake in a region in Denmark. Results of the second movement point to areas where analysis of Marxist activity theory benefits from double movements.

THE SECOND MOVEMENT – EVENTS AND ASSEMBLAGES OF ACTIVITY

The second movement affirms the previous measurements by Bourdieu and his system of concepts (*capital*, *habitus*, *field* and *practice*) as well as Marxist activity theory. Taken together they become the necessary tools and conceptualizations for constructing some of the strata which I will mention in the succeeding text. The measurement needs to go 'deeper' and 'higher' akin to Gabriel Tarde's sociology (Latour & Lepinay, 2009; Tarde, 1893) and in the last movement presented here various other measurements or quantifiables supplements the construction of the map of events. The map of events is a form of mapping and measurement, which replaces substances with events in a Deleuzian approach. Activity theory understood as Leontyev's systems of activity (Leontev, 1998) is in this movement seen in a Deleuzian way as assemblages of activity connecting concrete activity, thought and practice to various strata. The second movement is a process of taking the first movement of Bourdieu and activity theory through a theoretical movement of Deleuze with a specific interest in his reading of structuralism (Deleuze, 2004). The map of events is similarly influenced by Tarde and Foucault. The following text outlines exploration of science in upper secondary school. The approach is informed by conceptualizations in the first movement, as seen through the lens of a concrete project and line of research activity. The Danish Youth-to-Youth Project consisted of five gymnasiums; ten primary schools, each connected to one of the five gymnasiums; and one university, from which a body of mentors was recruited.

The data collected by this author focused on the five gymnasiums and the students therein. My ambition was to construct a whole ensemble of data in line with Ilyenkov's recommendations so as to map the problem regarding uptake in science. Various types of data were collected in concert with project activities. Examples of the data types are interviews with gymnasium students and university mentors, a large-scale longitudinal survey on attitude, socio-economic, and biographical data, observations gathered from project students, mentors, and teachers, and historical documentation about the region and the structures surrounding the five gymnasiums. This process covered a mixture of qualitative and quantitative data ranging from 2010 to 2014 gathered directly by the this author and indirectly through interviews, observations and documents. The survey included an account from the majority of all the students in the five gymnasiums in the period 2011-2014, i.e. four generations of students. The survey is an example of types of measurements and connected strata which enables for investigation and analysis of capital. I employed a statistical method called Latent Class Analysis (Collins & Lanza, 2010) for analyzing the dataset. This method for analzing the data opened up for a new relational perspective where unobserved relations could be drawn between the variables.

These four types of data also allowed the researcher to construct a map of various structural levels, or strata, which was again a step in analyzing the problem of uptake in science. Among these strata are the stratum of science *capital,* in which the researcher connected various factors to each agent as part of the data on collective qualities. The stratum of science *capital* is interrelated with the other strata in the exploration. For example, strata of activities like sports, music/art and leisure, strata of economy, strata of aesthetics and so forth. Categorization of strata offers a way of capturing expansion of measurement. A method which Tarde (1902) calls for in Psychologie économique because it is needed when capital/capitalism expands and colonizes other strata (Deleuze & Guattari, 1987). This author draws carefully on strata of science *capital* but also on related strata, which were determined in the exploration. But a break occurs where the above typical forms of data take on a different meaning due to the specific theoretical position invoked here. *The strata of science capital are not strata of human properties, attributes, or any kind of individual essences, but connected to a map of events and assemblages of activity.* This map of events and assemblages of activity is relational and the measured *capital* is never located inside the

individual but relationally placed in an assemblage of different structures and potentials within singular events. These events are both quantitative and qualitative entities (Deleuze, 2004). In fact my ambition is to map the symbolic and imaginary aspects of capital with several survey variables as seen in a imaginary and symbolic light. Similarly, this map shows various forms of labour surrounding and creating the agent's relative position in the map of science *capital*. Bourdieu (1984) and Lebaron (2009) used measurement of the participants' objects in their surveys. They attributed the typical class objects to specific clusters in the social field. This kind of relative measurement of objects was not used in this author's exploration due to considerations regarding the concrete case; *the fact that the youths live with their parents* so any objects accounted for in the above describe the parents' *capital/habitus* form. Therefore, some general pieces of information on education and the partent's types of employment was considered to be sufficient. This author's approach to mapping *capital* as a map of events and knots of assemblages of activity reveals another theoretical point. Deleuze's (1994) distinction and rendering of different strata follows Foucault's line of thought and identifies the archive, the map, and the diagram. Deleuze (ibid.) instigated the particular mapping used above. In the map, youth with a potentially high relational amount of science *capital* and subsequent *habitus* were surrounded by the following assemblages of activity: parents with a career in science or higher education and/or who had also attended a gymnasium, siblings who had also attended a gymnasium, high test scores in science and related science subjects as part of their curriculum in a gymnasium, and generally positive high-ranking interest in science and pursuit of a career in STEM areas.

These four points describing the enunciation of relations for a relative high amount of science *capital* are an assemblage of different forms of activity. The first and second points are a relative indicator of the milieu surrounding home activity, where inherited forms of labour affect the actual activity of the youth. The youth can get help with homework, become adept at mathematics/physic/chemistry, and receive a huge amount of help and scaffolding to grasp the meaning of abstract natural sciences. The remaining points are a relative indicator of the youth's activity at the gymnasium, where the former is a relative indicator of the *habitus* or skill in science and the latter a relative indicator of a discursive formation in which the youth positions himself or herself within a specific community of the gymnasium, labelled nerds, mathematicians, experts and so forth.

The given display of a specific case lies within a map of events constructed as a virtual form of science capital. The display suggests there is a relation between this map of events and the possibilities of the trajectories of the youths. It also suggests that they can only be explored after a certain time has passed. Elements of force and power in the various strata shape the youth's trajectories as series of singular events. However, this quality does not become visible solely from the point of view of science capital. Structure, on contrary, consists of enacting effects on structure, strata upon strata or diagram influencing the map and the archive. Bourdieu's (1984) analysis used an axis of economic capital and cultural capital to create a social field of dispositions. Here, other axes or strata are connected to the axis of science capital, in addition to the axis of economic capital. For example, the axis of geography shows the agents' placement in the geography of the studied region. In other words, through depiction of various axes or strata, the researcher constructs a map of events pointiong towards the problem of uptake into STEM, without indicating causality or a set of determinisms from this limited event in time. The described process of constructing a map of events illustrates an attempt to outline the construction of a new kind mapping, in which this author tries to implement Deleuze's imaginary, real and symbolic dimensions of structuralism. One can now return to the ramifications of seeing a mapping of assemblages of activities as a mapping of events in a dialectical light.

A MAP OF EVENTS – CAPITAL BEYOND ESSENCE

The notion of essence has plagued and continues to plague dialectical thought, but Deleuze (1994) shows there is a way out, an escape route through a new dialectical line of thought. His philosophical line of thought shares many similarities with the 'necessity of dialectical monism' proposed by Smith (2009). Monism is closely related to Spinoza and Leibniz and it is a crucial element of such ontology. Marx's sixth Feuerbach thesis (Marx & Enlels, 1978) shows that dialectical thought must go beyond essentialist thinking:

> Feuerbach resolves the religious essence into the human essence. But the human essence is no abstraction inherent in each single individual. In its reality it is the ensemble of the social relations. Feuerbach, who does not enter upon a criticism of this real essence, is consequently compelled: (1) To abstract from the historical process and to fix the religious sentiment as something by itself and to presuppose an abstract – *isolated* – human individual. (2) The human essence, therefore, can with him be comprehended only as "genus," as an internal, dumb generality which merely *naturally* unites the many individuals. (p. 145).

Deleuze (1990) proposes a new ontology based on the sense-event. For him sense takes on a role similar to the notion of *habitus* put forth by Bourdieu. For Deleuze, however, sense develops and expands in a philosophical line of thought. Deleuze's (2004) new reading of structuralism, and in accordance to his notion of event, what structure consists of, and how we recognize structuralism is of critical importance for taking "*Das Kapital* into psychology" and also for bridging various fields of knowledge. As a structural element, *capital* consists of real, imaginary and symbolic aspects. During the process of mapping the influence and topology of various forms of capital in human assemblages of activity, theses aspects need to be taken into account. Deleuze (2004) comments on the notion of the empty square or the paradoxical element form a critically new structural element in the map of events.

> All structures are infrastructures. The structural orders—linguistic, familial, economic, sexual, etc.—are characterized by the form of their symbolic elements, the variety of their differential relations, the species of their singularities, finally and, above all, by the nature of the object = x that presides over their functioning.(…) In each structural order, certainly, the object = x is not at all something unknowable, something purely undetermined; it is perfectly determinable, including within its displacements and by the mode of displacement that characterizes it.(…) As a result, for each order of structure the object = x is the empty or perforated site that permits this order to be articulated with the others, in a space that entails as many directions as orders. The orders of the structure do not communicate in a common site, but they all communicate through their empty place or respective object = x. (p. 188).

At this stage one needs to affirm and expand the concepts, models and arguments as supplied by Marx and Bourdieu. Standard socioeconomic analyses and similar statistical forms of measurement will only reveal to the educational researcher's individual contribution to the whole ensemble. Such ways of working often tend to reduce the complexity of the problem of education to crude caricatures with obscure denominators, categories, universals and topologies of types of students, families, settings or other. Such research returns to an essentialist view of knowledge and mental labour. To explore educational contexts properly is to take on the challenge of gazing at structural complexity. Unravelling the contents of such fields requires an effective way of mapping and measuring, to go beyond essence, to obtain a three-dimensional (real, imaginary, symbolic) image of the highlighted structures. More specifically, the particular connection between Deleuze's thinking and the heritage of Marx allows for a crucial bridging and encounter for reintroducing *capital* and a specific form of structuralism - transcendental empiricism and complementing activity theory. Put differently, analytical advantages emerge from bringing Deleuze's version of the empty square and paradoxical element into resonance with dialectical materialism. It hope that this contention enunciates the importance of efforts at bridging French thought by Bourdieu and Deleuze in this case and Marx.

CONCLUSION

The ultimate purpose of this chapter is to integrate *capital* into psychology and activity theory. The map of *capital* illustrates a map of events and in its pure sense it is a map of a *stunted game* with locked structures and numbed causalities, ultimately removed from pure chance. Deleuze (1990) comments on the stunted game.

> The characteristics of normal games are therefore the preexisting categorical rules, the distributing hypotheses, the fixed and numerically distinct distributions, and the ensuing results. The games are partial in two ways: first they characterize only one part of human activity, and second even if they are pushed to the absolute, they retain chance only at certain points, leaving the remainder to the mechanical development of consequences or to skill, understood as the art of causality. (p. 69–70)

This display of the researcher's process of mapping events is an attempt at revealing stunted as well as normal games going on between people, to vivisect and reveal inner causality and logic related to late capitalism among citizens in contemporary society. Even today, the notion of capital carries with it, as Shakespeare wrote "of your fair flesh to be cut off and taken" and equally a part of thought, body, and activity.

REFERENCES

Alrø, H., Skovsmose, O., & Valero, P. (2007). Inter-viewing foregrounds. *Working Papers on Learning and Philosophy*, 2007(5), 1-23.

Archer, L., DeWitt, J., Osborne, J., Dillon, J., Willis, B., & Wong, B. (2012). Science Aspirations, Capital, and Family Habitus How Families Shape Children's Engagement and Identification With Science. *American Educational Research Journal*, 49(5), 881-908.

Bacon, F. (2010). *Meditationes Sacrae and Human Philosophy*. London: Kessinger Publishing.

Bang, L. (2014a). Between the Cat and the Principle: an encounter between Foucault's and Bourdieu's conceptualisations of power. *Power and Education*, 6(1), 18-31.

Bang, L. (2014b). Welcome to school - welcome to the Empire-Building Business: an exploration and expansion of Bourdieu's notion of field. *Waikota Journal of Education*.

Bourdieu, P. (1977). *Outline of a Theory of Practice*. Cambridge, UK: Cambridge University Press.

Bourdieu, P. (1984). *Distinction: A Social Critique of the Judgement of Taste* (N. Richard, Trans.). London: Routledge.

Bourdieu, P. (1986). The forms of capital. J. Richardson (Ed.), *Handbook of theory and research for the sociology of education*. New York: Greenwood

Bourdieu, P. (1988). *Homo academicus*. Cambridge: Polity Press.

Bourdieu, P. (1990). *In other words: essays towards a reflexive sociology*. Stanford, CA: Stanford University Press.

Bourdieu, P. (1998). *The state nobility: elite schools in the field of power*. Stanford, CA: Stanford University Press.

Bourdieu, P. (2004). *Science of science and reflexivity*. Cambridge, UK: Polity Press.

Bourdieu, P., & Passeron, J-C. (1990). *Reproduction in education, society and culture*. Cambridge, UK: SAGE

Collins, L. M., & Lanza, S. T. (2010). *Latent class and latent transition analysis: With applications in the social, behavioral, and health sciences* (Vol. 718): John Wiley & Sons.

Deleuze, G. (1990). The logic of sense. New York: Columbia University Press.

Deleuze, G. (1994). *Difference and repetition.* London: Contiuum Group.

Deleuze, G. (2004). *Desert Islands: And Other Texts*, 1953--1974. New York: Semiotext.

Deleuze, G., & Guattari, F. (1987). *A thousand plateaus: capitalism and schizophrenia*. Minneapolis: University of Minnesota Press.

Ilyenkov, E. (1977). *Dialectical Logic: Essays on its Theory and History*. Moscow: Progress.

Kakkori, L., & Huttunen, R. (2014). Vygotsky, Heidegger and Gadamer on moral development. T. Hansson (Ed.). *Contemporary Approaches to Activity Theory. Interdisciplinary Perspectives on Human Behavior*. USA: IGI Global.

Lange, T., Johannesen, K., & Henriksen, T. H. (2010). *De unges veje gennem uddannelsessystemet i Nordjylland* (103). Region Nordjylland: Region Nordjylland.

Latour, B., & Lepinay, V. A. (2009). *The Science of Passionate Interests-An Introduction to: Gabriel Tarde's Economic Anthropology*. Chicago: Prickly Paradigm Press.

Latour, B., & Woolgar, S. (1986). *Laboratory life: the construction of scientific facts*. Princeton: Princeton University Press.

Lebaron, F. (2009). How Bourdieu "Quantified" Bourdieu: The Geometric Modeling of Data. K. R. a. C. Sanders (Ed.), *Quantifying Theory: Pierre Bourdieu* (11-29). London: Springer Science + Business Media B.V

Leontyev, A. N. (1978). *Activity, Consciousness, Personality* (M. J. Hall, Trans.). New Jersey: Prentice-Hall.

Marx, K., & Engels, F. (1904). *Das Kapital: Kritik der politischen* Ökonomie (Vol. 3). Hamburg: Meissner.

Marx, K., & Engels, F. (1978). *The Marx-Engels Reader*. New York: W. W. Norton & Company.

Osborne, J., & Dillon, J. (2008). *Science education in Europe: Critical reflections*. London: Nuffield Foundation.

Roth, W.-M. (2004). Activity Theory and Education: An Introduction. *Mind, Culture, and Activity*, 11(1), 1-8.

Roth, W.-M., & Lee, S. (2004). Science education as/for participation in the community. *Science Education*, 88(2), 263-291.

Smith, M. E. (2009). Against dualism: Marxism and the necessity of dialectical monism. *Science & Society*, 73(3), 356-385.

Tarde, G. (1893). *Monadologie et sociologie* (E. Alliez Ed.). Paris: Inst. Synthélabo pour le Progrès de la Connaissance.

Tarde, G. (1902). *Psychologie économique* (F. Alcan Ed.). Paris: Ancienne Libr. Germer Baillière et Cie.

Vygotsky, L. S. (1997). *The collected works of LS Vygotsky*, Vol. 3: Problems of the theory and history of psychology (R. V. d. Veer, Trans. Vol. 3). New York: Plenum Press.

Ziman, J. (1995). Postacademic Science: Constructing Knowledge with Networks and Norms. U. Segerstråle (Ed.), *Beyond the science wars: the missing discourse about science and society*. Albany: State University of New York Press

Ziman, J. (1996). Is science losing its objectivity? *Nature*, 382(6594), 751-754.

Zizek, S. (2012). *Organs without bodies: On Deleuze and consequences*. London: Routledge.

ADDITIONAL READING

Bourdieu, P. (1986). The forms of capital, J. Richardson (Ed.). *Handbook of theory and research for the sociology of education*. New York: Greenwood.

Grenfell, M. (2008). *Pierre Bourdieu: key concepts*. Durham: Acumen Publishers.

Harvey, D. (2010). *A companion to Marx's capital*. Lonson: Verso Books.

Parr, A. (2010). *The Deleuze dictionary*. Edinburgh: Edinburgh University Press.

Stolze, T. (1998). Deleuze and Althusser: Flirting with structuralism. *Rethinking Marxism*, 10(3), 51–63.

KEY TERMS AND DEFINITIONS

Capital: The researcher here sees capital as a relative indication of a structural disposition and potential in a temporal and spatial stratum. Capital is beyond money and represents various forms of value and sedimented labour.

Forms of capital: The researcher uses Bourdieu's differentiation of capital in economic, cultural, and symbolic/social capital. The researcher has conceptually explored scientific capital as a specific differentiation of cultural capital.

Habitus: The researcher uses Bourdieu's definition in the 'sense of the game', a concept encompassing the knowledge and skill (and within the realm of cognition and very much connected to activity) of how to use the specific disposition given or attained in the field (the specific form of capital). Habitus has no meaning without the concept of capital, since the two concepts are structurally entwined. Habitus is brought here into an encounter and movement with Deleuze's concept of sense, which expands it and brings it into philosophical line regarding sense.

Field: The researcher uses Bourdieu's definition of field as a specific temporal and spatial place where the above capital and habitus disposition manifest themselves. The researcher uses the word strata as a new concept evoked in the encounter and movement of Bourdieu and Deleuze.

Structural element: Capital is seen as a structural element with a real aspect, an imaginary aspect, and a symbolic aspect.

Strata: The various planes, or fields, in which the structural elements manifest themselves in various forms. The term strata is here used as a concept arising from the encounter between Bourdieu's concept of field and Deleuze.

Assemblages of activity: Akin to Leontjev's systems of activity, activity is seen here from Deleuze's point of view as an assemblage and connected ad infinitum to related activities in the strata. A concrete activity such as laboratory work in a science class is connected to activities in many other strata, not directly but in an assemblage.

Map of events: The topological kind of structural mapping Bourdieu put forth in his analyses encounters here Deleuze's concept of event. This means that the map proposed in this chapter's outlined methodology is a map of virtualities that are actualized in various parts of the strata. The quantitative and qualitative data gathered take a new meaning as actualized manifestations of the events plotted in the map. The map of events connects discourse,

various structural elements such as forms of capital, and other kinds of structural instances to topologically mapped events.

SHORT BIOGRAPHICAL SKETCH

Lars Bang is a PhD student at the Institute of Learning and Philosophy, Aalborg University in Denmark. This chapter is related to a research methodology and theoretical framework applied in the Youth-to-Youth Project, an educational bridge-building project with a specific interest in science education. He has a background as a teacher in special education and holds a Master's degree in Educational Psychology. His current research and teaching interests include science education, educational research, Marxism and the philosophy of science.

[5] THE LIVING ARCHIVE - BEFORE THE TABLEAUX OF SCIENCE AND ITS EDUCATION

Henry Frankenstein: Look! It's moving. It's alive. It's alive... It's alive, it's moving, it's alive, it's alive, it's alive, it's alive, IT'S ALIVE!
Victor Moritz: Henry - In the name of God!
Henry Frankenstein: Oh, in the name of God! Now I know what it feels like to *be* God!

(Whale, 1931, Frankenstein)

[5,8]´´´´´ THE LAST MOMENT OF NONSENSE WITHIN THE FIRST LIBRARY OF SENSE

Finally. The Structural Hero collapses before the door, and takes his very last breath as if it is the very first and last, leading to the sacred library. All the trouble, all the fights, all the rants have finally led him home, to the nexus of all things. The door is made of brambles, a living thing, and the Hero pulls them apart and enters the room. The Living Library is endless, this is the nexus of the surfaces. This is how the labyrinth connects to all things, through the Avatars of Force. It is a growing, living thing. Books are talking, walking among each other, comics flutter like colorful butterflies, TV Series and Movies are played, replayed on every living surface. Every artwork ever produced is visible, every music piece ever created is played again and again. This is finite infinity, everything and nothing is connected here. The Hero immerses himself in the virtuality and stays there for couple of lives, a couple of deaths. Standing in the Living Archive, the Hero has finally reached his result, arrived at the place of the Grail. From here he has the knowledge of all connections, here he is invincible when fielding his weapons, potentia incarnated. How could he ever leave such a place, become actual again and deal with the gritty muddy bare Life outside this Archive? The Hero ponders and wait for the final encounter with the mirror, the minotaur and time passes by instant upon instant, flight upon flight.

Dave Bowman: Hello, HAL. Do you read me, HAL?
HAL: Affirmative, Dave. I read you.
Dave Bowman: Open the pod bay doors, HAL.
HAL: I'm sorry, Dave. I'm afraid I can't do that.
Dave Bowman: What's the problem?

> HAL: I think you know what the problem is just as well as I do.
> Dave Bowman: What are you talking about, HAL?
> HAL: This mission is too important for me to allow you to jeopardize it.
>
> (Kubrick, 1968, 2001: A Space Odyssey)

[8,13]´´´´´ THE ARCHIVE OF SCIENCE AND SURFACES - A PROBABLE ACCOUNT OF WHAT HAS PASSED REGARDING THE INVESTIGATION OF CONCEPTS

> Realize that everything is connected to everything else (attributed to Leonardo da Vinci)

Da Vinci, cherished and worshipped by Science as perhaps the greatest inventor/scientist yet, knew how everything is and must be connected. Science and its education can thus not possibly be sequestered and cut from the rest of Creation in a rational move of Reason. There is a realm of surfaces connecting Becomings, Science and Being through series of structures. But these surfaces never follow a sensical path, not when we are talking about Becomings. There is thus more to be learned/connected regarding Becoming/Being in relation to Science in art, comics, music, literature and science fiction than in all the textbooks on Science ever scribbled down. Pierre Macherey showed precisely and exhaustively how literature opens up a specific space, connected to structure, which talks to philosophy:

> "All this leads me to return to the formula "literary philosophy" which I have just used and to specify its meaning. I have entitled the book in which it is explore: "What Does Literature Think About?" and not "What Does Literature Think?" In fact, I have rejected the conception according to which literature contains an already completely formed philosophy, to which it only has to own up. But I have attempted to show that literature, with its own means, also produces thought, in a way which constantly interferes with the procedures of philosophy. What does literature think about? could therefore also be extended as follows: What does Literature Make it Possible to Think About?" (Macherey, 1998, p. 23)

Science fiction, comics and other forms of 'pulp sci-fi' literature are thus related in intricate ways to Becoming and Being in Science, as an experimental smooth space of Thought. None showed this better than Arthur C. Clarke, Ursula LeGuin or Philip K. Dick, Grant Morrison and Alan Moore. Science fiction becomes the real science, which in turn inspires and propels forward the science fiction with new virtual possibilities, which again become actualized, inspire science and so forth ad

finitum. There is a flux, a broken jagged line of progressive mutation between Science and its education, between Science and its literature.

One of the investigations here has been of concepts within Science Education. This investigation of concepts is a surface, which connects to the problematic regarding Becoming and Being within Science and its education. [13,21]´ – [21,34]´ – [233,377]´

> The philosopher is expert in concepts and in the lack of them. He knows which of them are not viable, which are arbitrary or inconsistent, which ones do not hold up for an instant. On the other hand, he also knows which are well formed and attest to a creation, however disturbing or dangerous it may be. (Deleuze & Guattari, 1994, p. 3)

The flawed monstrous concepts in Science Education is thus the pivot, which cracks open Science and its education and lets the intrepid explorer vivisect and reassemble the concepts anew. Every concept has a becoming and a history, and these two anchors acted as the investigation of Scientific Literacy and Interest in Science. Every concept is a living thing constantly mutating, connecting, and eating up other concepts, notions and statements.

> In short, we say that every concept always has a history, even though this history zigzags, though it passes, if need be, through other problems or onto different planes. In any concept there are usually bits or components that come from other concepts, which corresponded to other problems and presupposed other planes. This is inevitable because each concept carries out a new cutting-out, takes on new contours, and must be reactivated or recut. On the other hand, a concept also has a becoming that involves its relationship with concepts situated on the same plane. Here concepts link up with each other, support one another, coordinate their contours, articulate their respective problems, and belong to the same philosophy, even if they have different histories. (Deleuze & Guattari, 1994, p. 18)

In the Archive the Structural Hero thus looked for concepts, their transformations and what they referred to in the field of individuation and intensities. Every concept in the investigation, and outlined as the Gorgons/Scientific Objectivity, has this connection to individuation, to the ‘individual in intensity’. There is a triptych of dark Science, a triage of intensive concepts of Interest in Science/Scientific Literacy/Scientific Objectivity. Concepts are thus linked to ontology in one direction and series of structures. In another direction they are linked to the realm of the real, to actualized structures in the form of curriculums, projects, exams, tests and so forth. Concepts in Science Education are linked to the ‘actualized concepts’ concerning the Map of the Investigation, and thus the proposed Mapping of Capital.

In other words, the concepts of Scientific Literacy/Interest in Science/Scientific Objectivity are linked to Bourdieu's concepts of Capital, Habitus, Field, and Practice.

[13,21]´´´´´ THE COMIC[S]-MACHINE – A DELEUZIAN READING OF THE WATCHMEN BY ALAN MOORE – EXCERPT FROM A PRESENTATION AT THE ANNUAL DELEUZE CONFERENCE 2014 IN ISTANBUL

[21,34]´´´´ ABSTRACT

This is an exploration of the special machine of the comic book or the graphic novel. The claim is that by tapping into the comic[s]-machine we can examine the voyages of the 'structuralist hero' (Deleuze, 2004a, p. 191).This particular comic[s]-machine is related to, and is perhaps par excellence, the empty square of science. This is 1985/2014 and the reading of The Watchmen will follow two structural series as they, through enumerations in the graphic novel, appear as changed, replicated and mutated images of science and capitalism. This is 2009/2014 and The Watchmen appear as a Time-Image directed by Zack Snyder. The assemblage between The Comic-Machine and the Time-Image will be explored and specifically its relations to the War-Machine and the Body-Machine. This investigation of The Comic-Machine of 1985 and the Time-Image of 2009 allows us to examine a specific manifestation of capitalism and how the image of science is evoked in the various transformations.

[34,55]´´´ INTRODUCTION – WHAT IS COMIC[S] ? - A SNIPPET FROM A FACIALLY PRESENTED PAPER

This presentation is one of the two series presented here at Deleuze Studies Istanbul. It is thus connected to a triptych of dark Science where some the problematics and creations mentioned here are unfolded further…

This is an experiment, an experiment of Thought and Extension – driven by joyful passions. Let us image that the 'thing', which I call comics, is something profound, something both finitely lesser and greater than what common sense perceives it to be. Let us image that comics is minor Literature in a Deleuzian sense.

But first let us set the scene for the experiment.

Comics have for me always been a profound object of joy; from reading Superman, Batman, Spiderman, Daredevil to enacting those stories in dashing plays with my friends wearing capes, hats and so forth in the garden, forest or wherever young boys AND girls went… Comics were something you collected, hoarded, read,

reread, traded and otherwise waited for week after week, month after month – you/I assembled an Archive containing profound experiences. In this experiment I will concentrate on what I will deem 'super-hero' comics and not go into the oeuvre of Tintin, Asterix & Obelix, Calvin & Hobbes, Lucky Luke and so forth. I hope those who love those comics and who are here today will forgive me this impasse.

This reading of The Watchmen and the experiment regarding comics in the general came out of this joy and is thus an affirmation and 'line d' frits'/line of flight from the usual critical/ideological readings from comics. It is not that I don't (in part) agree somewhat with Zizek's comments regarding Dark Knight, Avengers and other time-images of comics[8]. The problem is the Speed and the lack of joy – he reaches the conclusion too fast, too clear and distinct, negative and without joy. Lately when I am reading/rereading comics I hear Spinoza laughing behind my shoulder, a laugh pointing out, a sufficient Reason, the contours of an adequate idea in all comics – a becoming transforming the earlier totemic becomings.. But more of that later…

The experiment is situated in a series unfolding within my PhD, and the problematic of Science and Education, joy and Science, Science and becoming. The thought-experiment here is a productive detour, an alley with distorted mirrors, which in a way addresses some of the problems, which I have dealt with seriously in sociology and the philosophy, in a more profound and joyful way…. Comics have a wonderful overlooked specificity and intensity, which I wish to extend and enunciate here… Or perhaps I am really just looking forward to talking about to comics…

[55,89]´´´ THE STRUCTURALIST HERO

In further setting the scene for the experiment, a **term** or **denominator** is important to enunciate, both regarding the reading and its connection to Deleuze, is important to enunciate. The term is structuralism – and I am first and foremost a structuralist, a **fabricturalist** in a Spinozist way, an examiner of machines, semiotic, linguistic and so forth. One of the texts, and there are many of course, that helps me a great deal in examining, unfolding and thinking about comics is Deleuze's short text *How do we recognize Structuralism?(Deleuze, 2004a)*, which I am sure most/many of you are familiar with…

> So the question What is structuralism? is further transformed—it is better to ask: What do we recognize in those that we call structuralists? And what do they themselves recognize?— since one does not recognize

8 https://www.youtube.com/watch?v=VRp46PuZDek (Zizek comments Dark Knight)

https://www.youtube.com/watch?v=tP4pcDLI57c (Zizek comments Avengers)

> people, in a visible manner, except by the invisible and imperceptible things they themselves recognize in their own way. How do the structuralists go about recognizing a language in something, the language proper to a domain? What do they discover in this domain? We thus propose only to discern certain formal criteria of recognition, the simplest ones, by invoking in each case the example of cited authors, whatever the diversity of their works and projects.(Deleuze, 2004a, p. 171)

Deleuze is writing about the structuralists Foucault, Lacan, Althusser and Levi-Strauss looking for a common denominator, a ‘thing’, by which to recognize a structuralist hero. Structuralism is further seen in the light of axiomatics (symbolism) and calculus (structuralism):

> Sometimes the origins of structuralism are sought in the area of axiomatics, and it is true that Bourbaki, for example, uses the word "structure." But this use, it seems to me, is in a very different sense, that of relations between non-specified elements, not even qualitatively specified, whereas in structuralism, elements specify each other reciprocally in relations. In this sense, axiomatics would still be imaginary, not symbolic properly speaking. The mathematical origin of structuralism must be sought rather in the domain of differential calculus, specifically in the interpretation which Weierstrass and Russell gave to it, a *static and ordinal* interpretation, which definitively liberates calculus from all reference to the infinitely small, and integrates it into a pure logic of relations. (Deleuze, 2004a, p. 176)

Deleuze overturns structuralism and in a way, he becomes a structuralist of bodies, planes and strata – he affirms it and the ‘structuralists’ within in a most heretical and joyful way.

The Structural Hero is presented as:

> Thus, there is a structuralist hero: neither God nor man, neither personal nor universal, it is without an identity, made of non-personal individuations and pre-individual singularities. It assures the break-up [I'e'clatement] of a structure affected by excess or deficiency; it opposes its own ideal event to the ideal events that we have just described. For a new structure not to pursue adventures that again are analogous to those of the old structure, not to cause fatal contradictions to be reborn, depends on the resistant and creative force of this hero, on its agility in following and safeguarding the displacements, on its power to cause relations to vary and to redistribute singularities, always casting another throw of the dice. (Deleuze, 2004a, p. 191)

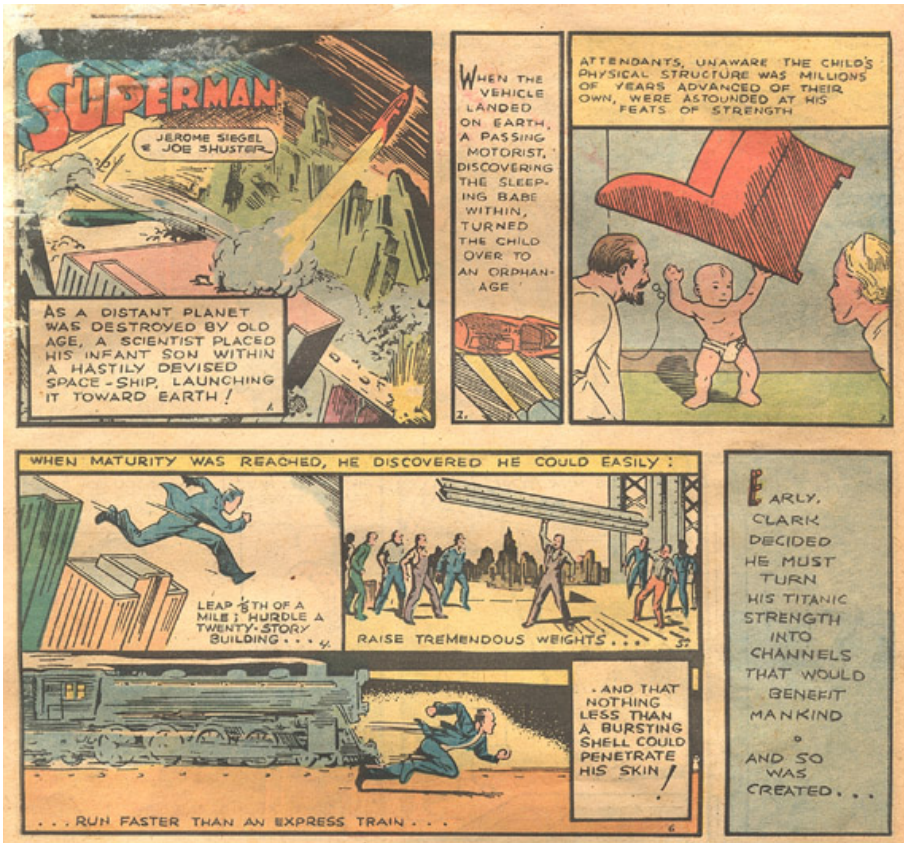
What does this Structural Hero, this specific structuralist have to do with comic[s]? And what kind of relation is there between the structuralist hero/villain and science?

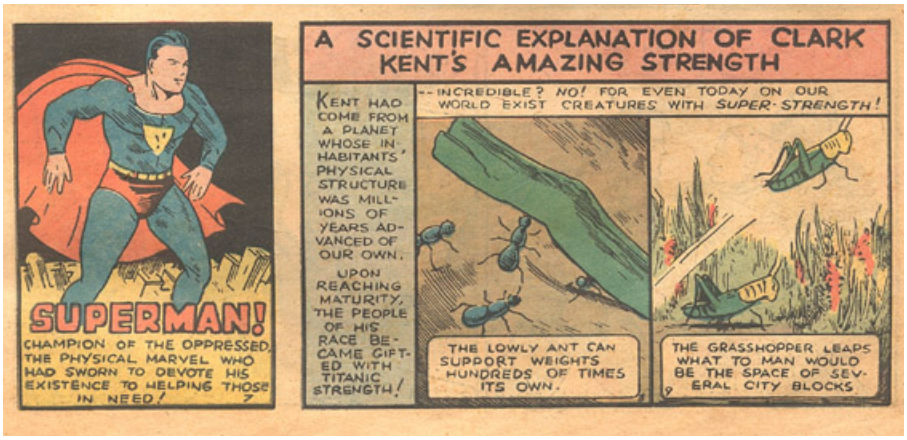
[89,144]´´´ ACTION - COMIC[S]

To examine that I return to the specific series, both in a Deleuzian and real sense, in terms of series of comics. Unfolding without an author, without a subject, with an impersonal force.

Comics is 'serial literature' par excellence. 'Within' the comic there is a serial unfolding of images and text. 'Without' the serial unfolding is noticable in the weekly and monthly production of specific comic series.

Action-Comic #1 heralded a new birth, a new Superman.

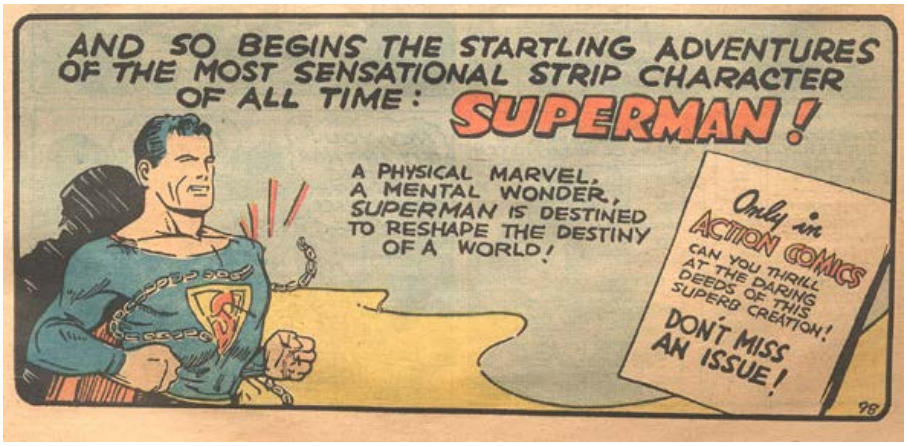




Now comics weren't simply comics, but movement-comics, and the new hero was connected to rushing trains and engines, buildings and construction, but first and foremost there was a scientific explanation to every power he had. The meta-human, superman, was explained in scientific terms. Superman has unfolded since 1938, mutated, explicated, killed, expanded. It is as if a murmur expresses from within the images and text and from without. Authors touching and developing upon the line, the series. And so it goes, the series unfold… akin to the gaze of the never-ending unfolding future/past Billy posseses in Kurt Vonnegut's *Slaugtherhouse-five* (2000).[xxvi]

There is a great mover in the comics-machine, sator arepo tenet opera rotas, the machine itself, the object = x. Structure envelops a wholly paradoxical object and element. In Superman, visible on the very first page (figure xx), science and Superman go hand in hand, and the movement, displacement between them is the [empty square], which almost but never really becomes science. In the first comics, he can't fly but leaps tall buildings in a single jump, he isn't completely invulnerable but 'nothing less than a bursting shell could penetrate his skin'. In short 'the man of steel' is was in the beginning in 1938 explained, imagined, understood and reasoned in scientific terms.… As the series evolve and mutate we learn he is from another planet called Krypton, has 'heat vision', 'x-ray vision', 'frost breath', is only vulnerable to a specific mineral kryptonite, which can harm or change him. Kryptonite exists in the whole spectrum of colors.

To explicate the specific relation between unfolding series within superhero comics and science further we turn to The Watchmen, as a concrete case of a more contemporary serial unfolding within comics.



[144,233]´´´ THE WATCHMEN OR WHO WATCHES THE WATCHMEN?

The graphic novel *The Watchmen* by Alan Moore (Moore & Gibbons, 2005) is a work exemplifying par excellence series within series, unfolding lines of structure and images moved by a paradoxical displacing element of science, the object = x. The setting is a past/future of the 1980's where Nixon is still in power and the world is on the brink of a nuclear holocaust. The novel is overall crafted as if it is a journal belonging to the investigator Rorschach, one ofthe Structural Heroes of the series within. Within this 'journal' there are series unfolding where we follow different Structural Heroes and how they relate and connect to the problematic at hand – the problematic related to an impending nuclear apocalypse due to the appearance of Dr.Manhattan. Additionally, a paradoxical series of The Black Pirate unfold in the novel, and the tale of the pirate, semmingly at first unrelated to the tale proper, mimics and displaces the overall theme and mood of the graphic novel or 'journal of Rorschach'.

The series within begin with a fall, a drop to the surface, similar to the futurist painting "Before the parachute opens". The death-fall triggering the semmingly necessary 'fall from grace' in the Watchmen is none other than the death and fall of the Comedian; his death initiates a structural unfolding of series within the comic. The Comedian's death is necessary seen from one of the series of science within the graphic novel, from the series of Oxymandiaz (but we only learn that in the end of the novel). The fall of the Comedian is similarly 'the fall', or the paradoxical displacement, of the two structural series related to science, the series of Oxymandiaz and Dr. Manhattan.

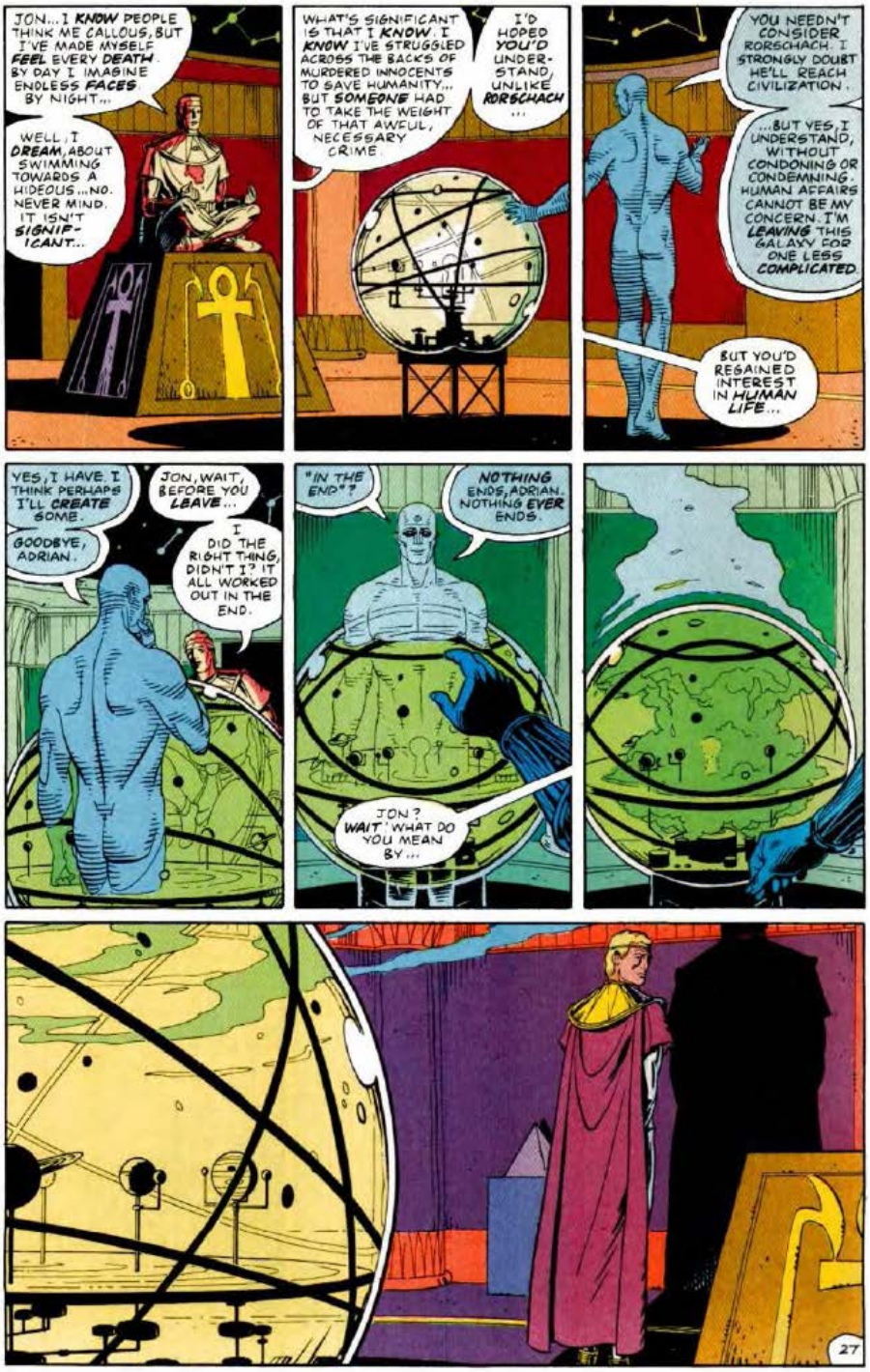
Two series within the Watchmen are here of special interest and are in a particular way connected to Superman and science: the characters of Oxymandiaz and Dr.

Manhattan. These two series are connected to the structural series regarding the Science-Image.

Dr. Manhattan is presented as a series, and a Structural Hero, close to the Image of Superman. He is the only one within the novel exhibiting superpowers, and he is seemingly Godlike. He can do anything, teleport, disintegrate everything, see the past and future unfold; in short, he is the pure creator/destroyer and losing the remains of his humanity piece by piece. Like stated early in the novel by a newsman. “There is a superman and he is American.“ Dr. Manhattan is the series of the Science-Image actualizing the pure Scientist, the cold distant logic, whose powers lets him gaze upon the clock of creation, a clock without a clockmaker. Dr. Manhattan strives to solve the world’s problem to deliver clean sustainable, eternal energy with Oxymandiaz (whom we only learn later is the ‘villain’ or misguided ‘hero’ of the series). The very existence of Dr. Manhattan have thrown the world into a cold war escalating towards a nuclear apocalypse, since the Russians have to respond to the American Superman. The unfolding series of Dr.Manhattan thus actualize a specific structural series related to the Science-Image, which is connected to the overall discursive formation of Science and particularly the utopian mold of Being-Scientist.

The other structural series related to science, unfolding within the novel, is the series of Oxymandiaz. Oxymandiaz is ‘the most intelligent man alive’, a Nietzschean Superman, and an avatar of human perfection. This series is first in the end revealed as the Structural Villain of the series. This villain is driven by a calculated necessity, a true humanistic spirit, and invoking a masterplan, which will save the world of nuclearholocaust through the killing of a few millions. This cold calculation is a different actualizing of the structural series of the Science-Image than we saw with Dr. Manhattan. The coldness of Oxymandiaz’s isn’t because of godlike powers and a distance with humanity but through a human humanistic coldness, a necessary numbing and acceptance of doing the necessary ‘all in the name of science and the world’.

These two series of the Science-Image unfold through the displacing paradoxical element of science. In the ‘end’ Oxymandiaz wins, his masterplan is carried out and nuclear holocaust becomes averted through the death of a few millons. Dr. Manhattan leaves the world, and when he answers Oxymandiaz question (who knows that Dr. Manhattan can see the unfolding future and past) of the future he paradoxically says ‘nothing ever ends’. [And so it goes] – $[\infty,\infty+1]$



The above image is from Chapter XII p.27 of the Watchmen (Moore & Gibbons, 2005)

[233,377]´´´ A TRIPTYCH OF DARK SCIENCE – A VIVISECTION OF MONSTERS

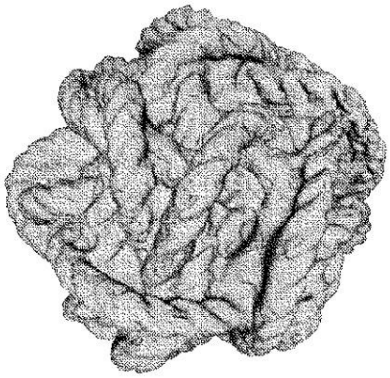


Image of knot nr. 1001 (out of 1001 prints). Presented by Anders Bang during the presentation of the Triptych of Dark Science.

[377,610]´´´ ABSTRACT

Science begets machines. Science begets monsters. This presentation is a joint presentation of a triptych of dark Science – both in an oral presentation and in the actualization in an artwork (by Anders Bang). The triptych consists of three monsters – the Chimera, the Ouroboros, the Medusa. These monsters of myth are here connected to three concepts of science education (minor science) Interest in Science-Chimera, Scientific Literacy-Ouroboros and Scientific Objectivity-Gorgon/Medusa. Myth is thus in an assemblage with science and this relationship of a particular becoming-animal (becoming-chimera, becoming-ouroboros, becoming-medusa/gorgon) with science resonating through contemporary research in science education. These assemblages are here seen as what Deleuze and Guatarri called 'dark assemblages' (Deleuze & Guattari, 1987, p. 242) as form of a deep rhizome, and in a sense, a mirror of the proper concepts of interest in science, scientific literacy and scientific objectivity and the Becoming associated with science.

The oral presentation will include an outline of the historical and conceptual research, which assembles the above connecting myth, science and science education.

[610,987]´´´ BEFORE THE PARACHUTE OPENS - OUTLINE OF A FUTURE (WORK)

Figure 2 Tullio Crali's painting "Before The Parachute Opens" (1939). Rendered by Christian Bang

[987,1597]´´´ THE FALL OF SENSATION - FLYING DOWNWARDS

There is a necessary fall concerning the triptych of Dark Science, and the concepts in assemblage with it. There is a necessary fall in learning in relation to art and to the Becoming related to intensities. There is a necessary relation between sensation and learning.

> In Bacon, primacy is given to the descent. Strangely, it is the active that descends, that plunges. The active is the fall, but it is not necessarily a descent in space, in extension. It is the descent as the passage of sensation, as the difference in level contained in the sensation. (Deleuze, 2003, pp. 80-81)

Can the Fall, learning to fly downwards, be prepared or structured? Is it an effort of the will to power, like Superman in The Man of Steel, an alien will making him escape the earth and truly to fly/jump in a perpetual infinity?

Sensation begets the Fall, the Fall begets learning. The teacher and the apprentice thus focus on sensation to initiate the drift and the plunge. And could you do anything else in Science? Doesn't 'scientific learning' involve tasting/smelling the lightning, feeling the sudden jolt of electricity, feeling the hand cramp up when expose to the forces of electricity? Science cannot begin as anything else but in sensation. All concepts in science, whether it is physics, biology, chemistry etc. have sensation as the foundation. The axiomatic comes much, much later. It is through sensation that the axiomatic can be redefined, contested and mutated.

[1597,2584]´´´ FUTURISM, VERTIGO AND FASCISM⌡FACEISM

Tullio Crali's painting, "Before the parachute opens", induces a specific kind of vertigo, a specific kind of technological fall. Futurism is connected to science and technology in its purest sense, and the artists within the movement try to reach a new Becoming, a new man.

> If we grant the transformational hypothesis of Lamarck, we have to recognize that we are aspiring to the creation of an inhuman type, one in which moral suffering, generosity, affect, and love will be abolished, poisonous corrosives that sap the inexhaustible supply of vital energy, interrupters of our powerful physiological electricity.
>
> We believe in the possibility of an incalculable number of human transformations, and we declare without a smile that wings are waiting to be awakened within the flesh of man.(…)
>
> This inhuman and mechanical type, constructed for omnipresent velocity, will be naturally cruel, omniscient, and combative. He will be endowed with unexpected organs: organs adapted to the exigencies of an environment made of continuous shocks. Already now we can foresee an organ that will resemble a prow developing from the outward swelling of the sternum, which will be the more pronounced the better an aviator the man of the future becomes, much like the analogous development discernible in the best fliers among birds.
>
> (Rainey, Poggi, & Wittman, 2009, pp. 90-91)

The movement of the futurist inevitably became associated with fascism, and with Mussolini's new vision for Italy. The vision of the new man, technology and

industrious Becomings thus became a new fascist man, an enemy of Feminism, of any sort of intellectualism.

> 9. We intend to glorify war—the only hygiene of the world—militarism, patriotism, the destructive gesture of anarchists, beautiful ideas worth dying for, and contempt for woman.
>
> 10. We intend to destroy museums, libraries, academies of every sort, and to fight against moralism, feminism, and every utilitarian or opportunistic cowardice.
>
> (Rainey et al., 2009, p. 51)

In a way, the futurists affirmed science and technology, took it to its brink, its edge and its fall. They pushed through all the half-realized attempts to integrate science and technology with humanism and showed a new form of in-humanism. Futurists showed us a future, the 'true affirmed future', future of science and scientism as envisioned, even before Orwell's "1984" in 1949. They showed us how science, technology and a specific form of fascism are related to the dream of progress-futurism becomes striated progress affirmed and taken to its brink. Futurism showed us the specific capitalistic delirium induced through technology and the war machine.

Before the parachute opens is vertigo, the rush of the rising earth, of the technological induced fall and survival. The painting shows what is yet to become, and what always will become in a union between science and technology. One is thus faced with two types of fall related to Becoming, a fall of Sensation and a fall of Technology and capitalistic delirium…

[2584,4181]´´ HERE THERE BE DRAGONS - QUALITATIVE AND QUANTITATIVE INVESTIGATION OF STRUCTURE

> Watching a coast as it slips by the ship is like thinking about an enigma. There it is before you - smiling, frowning, inviting, grand, mean, insipid, or savage, and always mute with an air of whispering, Come and find out. This one was almost featureless, as if still in the making, with an aspect of monotonous grimness. The edge of a colossal jungle, so dark-green as to be almost black, fringed with white surf, ran straight, like a ruled line, far, far away along a blue sea whose glitter was blurred by a creeping mist.(Conrad, 1990, pp. 113-114, Heart of Darkness)

[4181,6765]´´ TRACING DRAGONS IN NORTHERN JUTLAND - REPETITIONS OF DISCOURSE

At the edges of old maps, stating the unknown, the phrase *hic sunt dracones* would be enunciated - “here are dragons”. On the precipice of Understanding, of mapped Reason, monsters appear warning sailors and travelers about the dangers of the unknown. Mapping the world has been associated with initially mapping the coastline before venturing into the dark blotches of the unknown, inner parts of the land. It is from the coastline, looking from the sea towards striated land, that the imagination begins to take flight. Smooth space contemplating striated space, listening to the sounds of Africa in the dark, seeing the glistening moisture of the jungle rising - like an impenetrable cloud ascending from the inner land.

The mapping of the YtY - project, through the Principle of the Cat, has been such an attempt at such a cartography. Always mapping from the coastline, staying at the surface, the very edge of striated space, looking inward. Every method employed has been contaminated by that stance, of mapping a surface caught between smooth and striated space, mapping from within the rupture of a fold. The problem of the rural/outer youth vs. the city/inner youth is connected to the problematic of mapping the unknown and Striated ∫ Smooth space. One will always see with ‘old’ eyes upon the new and the other, reproducing either what ought to be seen, or affirming an already formed Reason and Understanding of the problem. To escape this conundrum the choice was thus to stay at the surface: to map the surface of discourse connecting youths, to science, to Becoming and to Being, to draw in as many relations and surfaces as possible to create a map of the rural youths.

> To say that one discursive formation is substituted for another is not to say that a whole world of absolutely new objects, enunciations, concepts, and theoretical choices emerges fully armed and fully organized in a text that will place that world once and for all; it is to say that a general transformation of relations has occurred, but that it does not necessarily alter all the elements; it is to say that statements are governed by new rules of formation, it is not to say that all objects or concepts, all enunciations or all theoretical choices disappear. *On the contrary, one can, on the basis of these new rules, describe and analyse phenomena of continuity, return, and repetition: we must not forget that a rule of formation is neither the determination of an object, nor the characterization of a type of enunciation, nor the form or content of a concept, but the principle of their multiplicity and dispersion.*(Foucault, 1972, p. 191, my emphasis)

The methods employed in the YtY - cartography are thus transformed methods, adapting to the specific methodology, the Principle of the Cat, of the dissertation. The methods are adapted and transformed to facilitate and investigation of the

surface and they bear the liking of the writings of Foucault, Deleuze and Bourdieu but of course in a hybrid mutated un-true version.

The interviews of the rural youths are thus seen from, this methodological perspective, as if looking upon a coastline of a discursive formation related to the questions/statements the interviewer/interviewee brought forth. The interviews thus act as a lens, a telescope, looking upon the discursive formation connected to science and the problematic of Becoming and Being in Science. The arguments the youths draw upon are seen as coming that from that discursive formation, from that particular cask of Reason. In other words, their statements are not 'their' own but belong to the whole realm of discursive formation, and surfaces of science (both series of the Science - image and the Science - structure), which they drawn upon. The usual interview strategies are thus void here, there is no inner meaning, and no attempt to delve underneath the statements to get at 'the real gold' underneath. The surface, the stereotypes the youths draw upon are the crux of the matter here, the 'multiplicity and dispersion' of the statements regarding Science, Education and related discourses. This means that the interview guide was only a 'semi structural guide' (but really a full blown weapon of the Structural Hero), a small dimly lit lantern, which only acted as the first instance and vehicle in the search and discourse with the students.

The interviews were enacted in a group frame, precisely to escape the notion of the 'I think', to enter into the 'We think' and to emphasize and cultivate the 'surface of discourse'. In summation, 18 interviews with groups ranging from 2-4 students have so far been conducted.

The interviews with the mentors of the youths (those directly dealing with youths, who were giving them a different type of counseling and knowledge regarding studying at the university) were done similarly. Although they were interviewed in a solo interview, where the interviewer was interested in their explanations of their background, of how and why they ended up as mentors and had interest and skill in counseling youths who were confused regarding their educational choice, and especially one in science. Here the focus was similarly on the discursive formation but as seen from 'within the jungle', of the already converted savage who now wanted to help the other 'lost savages' of the tribe.

The survey of the rural youths was done in the same methodological stance as above. The survey has run, is still running, 'on' four generations of 2nd year students in upper secondary education (gymnasium/STX). So far, a total of 1,955 youths have participated in the survey ranging from four rural gymnasiums in Northern Jutland and one city gymnasium in the largest city in the region. The survey contained 36 variables, making the total repetition of discourse the sum of 70380 statements (and that is before the real multiplicity of creative categorization has begun).

The survey contains two themes enunciated in different types of questions: 1. Questions aimed at gathered statements regarding the surface of science, of course within the fixed frame of the questions of the survey. The statements are related to the 'attitude towards science', which factors the students draw upon to explain yes/no/conflicted regarding an educational career in science. The questions are thus not seeing the 'attitudes' or 'answers' from the youths as their own but again stemming from the discursive formation of Science, and thus a multiplicity of surfaces, which the youths draw upon to explain their 'choice' or 'attitude'. 2. The second line of questions is so called 'data questions'. Here the students indicate specific factors, that seems to have an impact on educational choices. The factors are concerning the socio-economic status of the parents, family factors regarding the youth (both historical and contemporary), where the students live in the rural area and so forth. The survey is similarly to the interviews transformed through the methodological approach of the investigation. It loses its 'quantitative aspect' and becomes 'qualitative statements in repetition'. The quantitative aspect is a discursive one, and all the statistical analysis brought to bear upon the 'data' assumes this particular form. This means that any kind of 'prediction', 'regression', or 'probability' becomes a discursive one. It is as if statistics in the same movement are both enlarged and diminished.

[6765,10946]´´ AN ANALYSIS STILL IN THE MAKING, A MAP STILL BEING DRAW

In the article *Welcome to school* there is an example from one of the interviews conducted and a general indication of some of the 'findings'/surfaces vivisected in the analysis. Two things are so far seen in the interviews, thus indirectly from the statements of the youths and how their arguments are drawn from the discursive formation of science: 1. A specific Habitus, which the Structural Hero names Homo empiricus. This Habitus is reassembled from the account of the youths, both those from within and without the scientific subject lines in the institutions. It indicates, in a specific way, how a 'science student' behaves, acts and thinks about his or her studies. It is thus a specific Habitus being fostered and molded in the institutions, a Habitus, which is seen as originating within the scientific field proper and thus connected to the overall discursive formation of science. This Habitus is a proper Bourdieuian Habitus and connected to his outline of an investigation of the scientific field (Bourdieu, 2004). This scientific Habitus is vivisected and assembled from the whole of the empircal material and all the surfaces connected to this. It's a 'creative movement', an inductive, or perhaps hyper-deductive, vivisection. Accompanying this Habitus of Homo empiricus is a rationality, titled The Man of Science by the Structural Hero, that acts as the discursive frame of Being-Scientific and is related to the discursive formation of Science, indicating how a proper scientist acts, thinks and behaves. The rationality is what enforces, through the positioning in the field of the institution, the Habitus - they are two sides of the same coin. There is of course not just 'one' rationality, and many of the

rationalities previously encountered in the Chimera and the Ouroboros (Moral, Measurement, Mind, Helical, Momentum), connects serially and structurally to the Man of Science.

The survey findings are still being drawn, outlined and analyzed. The specific analysis being used is called Latent Class Analysis (LCA). LCA is the wet dream of a structuralist, and if Lacan, Foucault, Althusser had been alive today, they would probably rejoice over this new marvelous tool/weapon for a Structural Hero.

> As the name implies, LCA is a latent variable model. Readers may be acquainted with other latent variable models: for example, factor analysis.(…) The term latent means that an error-free latent variable is postulated. The latent variable is not measured directly. Instead, it is measured indirectly by means of two or more observed variables. Unlike the latent variable, the observed variables are subject to error. Most statistical analysis approaches based on latent variable models attempt to separate the latent variable and measurement error. The scientific literature has used a variety of terms for latent variables and observed variables. Latent variables are often referred to as constructs, particularly in psychology and related fields. (Collins & Lanza, 2010, p. 4)

Thus the observed variables in the dataset of the survey are only used indirectly, to localize through estimations of probability the intensive murmur of background noise. Therefore, LCA becomes a creative tool for examining and creating structures and their relations in the dataset. The survey becomes a mapping of the actual, not real, a search for the organizing principle, class, of the actual. In other words, the statistical analysis becomes transformed here to be the search for the 'key' to the discursive formation of Science. IT never enters the real, but acts as the displacing element in the structural series. Statistics, in the specific version outlined here, becomes a way to almost glimpse at the empty square of Science, glimpsing at the vacuum of class just before it gets contaminated with meaning.

[10946,17711]´´ A VIRTUAL LECTURE ON THE LOGIC OF SCIENCE ∫ THE LOGIC OF SENSE

> The concept of pure science and its deduction is therefore presupposed in the present work in so far as the *Phenomenology of Spirit* is nothing other than that deduction. Absolute knowledge is the truth of all the modes of consciousness because, as the course of the *Phenomenology* brought out, it is only in absolute knowledge that the separation of the *subject matter* from the *certainty of itself* is completely resolved: truth has become equal to certainty and

> this certainty to truth. (…) This objective thinking is thus the *content* of this pure science.
>
> (Hegel, 2010, p. 29, original emphasis)

> Taken in themselves clarity and distinctness do indeed relate an idea's content, but they relate only to its "objective" or "representative" content. They also relate to the form, but only to the form of "psychological consciousness" in the idea. *They thus allow us to recognize a true idea, the very idea presupposed by the Method*, but give us no knowledge of the material content of that idea, nor of its logical form. Moreover, clarity and distinctness cannot take us beyond the duality of form and content.
>
> (Deleuze, 1990, p. 132, original emphasis)

One of the problems of this thesis is connected to the above differen*t*iation /differenc*i*ation. It starts with the problematic of sense, which Deleuze explored in his book *The Logic of Sense* (Deleuze, 2004b). How do we make sense of something? This question is connected in Deleuze's terms to a philosophy of the event and placed in the very heart of things. It has been explored as long as there have been a 'human condition' conveived by shamans, philosophers, priests and so forth. Deleuze returned to the stoics and placed sense in close relation with the event. Additionally, through examples from Lewis Carroll's work, there is a paradoxical relation between sense and non-sense, non-sense being the object = x. This particular relation is of intensive importance to all things related to science and the understanding of things.

Science is our attempt to make sense of all the phenomena around us, and in modernity this encapsulates the whole of creation. Science is the sense-maker, the machine we use to explain everything in nature. But here we arrive at the problem, which Deleuze and Guattari briefly touched upon in Thousand Plateuaus - the problematic between Royal/Major/State Science ∫ Nomad/minor/Ambulant Science. Science is split by this differentiation, between a Royal axiomatic Science and a minor Science of calculus and related things. Between these two 'models' there is what I have previously termed dark Science. Dark Science is a science of non-sense, beyond even minor Science, strange products, which have no real classification in either Royal Science (especially not there) or minor Science, products of fiction with scientific elements, who in some strange way predict and influence the flows of Science. These strange products of the above function and split are connected in an assemblage to a multiplicity of related/non-related statements and objects. Thus dark Science is connected to the non-sense of the world, and is thus not just virtual/actual but real/Real. Whales with unicorns horns, two headed snakes, giant squids, black holes with unlimited gravity – all of these

phenomena and infinitely more are what evoke this non-sense, inspiring scientists, artists and authors to explore and create brave new worlds and concepts. Dark Science is thus at the heart of Science itself. It is the real experiments that never reach the purity of the axiomatic equation and calculation, it is the inexhaustible function of pi and so forth. In other words, dark Science is an intrinsic and chaotic part of Science it self and manifests on the plane of Immanence simultaneously as a real/Real manifestation.

There is a specific exorcism taking place between Royal Science and minor Science, especially between Royal Science and dark Science. Our sense-making machine must remain pure and there is really no room in Royal axiomatic Science for either minor Science or dark Science. Minor Science can sometimes move to Royal Science and vice versa, as with the example of chemistry, but dark Science has always been relocated to artists, madmen and authors… Though the paradoxical manifestation is that all the 'great' scientists are also 'dark' scientists, and many have been quite explicit from what strange resources they drew their inspiration to create their breakthroughs and new conceptualizations (Cassidy, 1992; Pais, 1982, 1991). This exorcism is reproduced in education, and this creates particular problems related to Science education and the structured teaching aimed at becoming-scientist.

Thus there is no great teleological 'Logic of Science', as Hegel proposed for the Science of Logic, merely a minor and dark Science. This dark Science escapes, mutates and fluctuates through a nomadic dispersion and distribution. The overall progress or nature of the 'Logic of Science' in the striated space of the scientific field thus 'merely' result of the conversion of smooth spaces of Thought, containing nonsense, art, science fiction and all the other exorcised products of Reason (dark Science). The word=x, the person=x, the action=x, the object=x - all these things are the 'real' logic behind Science, the true displacing paradoxical element of 'progress', thus reversing and overturning Hegel, and his 'negative' consciousness and absolute Knowledge.

[17711,28657]´´ EPILOGUE: BETWEEN TERRA INCOGNITA ∫ MARE COGNITUM

The Structural Hero looks upon his weapons and rejoice. The weapons given to him, the trident of the depths, the ring of creative Will, the Speed-Force were the weapons of the rupture, of the drift, weapons allowing him to gaze faster, create more, cut deeper. When their power has been spent they have to be destroyed, exchanged and reassembled. No weapon outlives its battlefield, no weapon outdates its conflict.

[28657,46368]´´ ARTICLE: WELCOME TO SCHOOL

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Welcome to school—The empire-building business—an affirmation of Bourdieu's concept of field

Lars Bang
Institute of Learning and Philosophy
Aalborg University

Abstract

Globalisation has transformed and changed people's lives around the world, with education's role having undergone a similar metamorphosis. In many countries, educational institutions have transmuted into new types of institutions, with schooling emerging as a competitive product of this globalised economy. The result: a higher education arms race pitting country against country, school against school, and pupil against pupil. The rationale: the nation with the best schooling producing the most successful pupils has the highest chance of securing future growth and progress for its respective society. In order to gauge and compare schools, we now are equipped with globalised measuring tools that calculate school quality within each nation-state. How is the process manifested within schools, and how do we trace the practices, rationalities and other entanglements from separate interests/fields in contemporary schooling? This article offers an expanded notion of Bourdieu's concept of field that can assist educational researchers in focusing on a particular educational field using a conceptual tool to trace such practices, rationalities, and entanglements across different fields. Bourdieu's ideas are interwoven with Foucault's and his historical gaze, through Foucault's methodology of archaeology. When examining an institution, practice or any other phenomenon in the educational field, we must ask, "Which will wills it?" and which historical conditions allow a particular phenomenon to exhibit contemporary manifestations. This article proposes a framework using the image of quasi-self-similar fractals to highlight entanglements between multiple semi-autonomous fields. This image of thought is constructed to capture the specific role the economic field plays in relation to all other fields and to consider how every field is thus a power field. To exemplify this argument, empirical data from a Danish regional project will be used to show how the above-mentioned methodological encounter between Bourdieu and Foucault and the concept of field can be applied. Equipped with this framework, the example explores and illuminates 1) a specific scientific habitus fostered within the educational field Homo empiricus; 2) the rationality or discursive formation supporting 'the Man of Science'; and 3) how the two are related to the 'empire-building business' or, in other words, how to market and sell certain aspects of schooling.

Wilf Malcolm Institute of Educational Research, Faculty of Education, University of Waikato, Hamilton, New Zealand
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Key words

Bourdieu, Foucault, Deleuze, Field, Science Education

The business of empire-building in education

This article is an outline to analyse a specific issue regarding the relation between the fields of science and education and thus an investigation of the scientific domains in lieu of frameworks put forth by Pierre Bourdieu (2004) and Michel Foucault (1970). I propose four important conceptualisations or 'expansions': 1) the empire-building business in education as a particular aspect of several fields' influence upon the educational field; 2) the image of a quasi-self-similar fractal as a new image of thought (Deleuze, 1994, pp. 164–208) used to understand field multiplicity and their influence upon each other; 3) Bourdieu's field concept (1977, 1983, 1984, 1994, 1998b, 2005) encountering Foucault's discursive field (1972); and 4) the relation between Foucault's concept of discursive formations (1972) and Bourdieu's concept of habitus and doxa (1977, 1990b). The article's structure is thus first an encounter between Bourdieu's and Foucault's field concepts that leads us into a fresh image of thought—the quasi-self-similar-fractal—and how this fresh image is drawn into an empirical material analysis. The encounter is meant to be an affirmation, rather than a critique, of both Bourdieu and Foucault through the underlying guidance of Deleuzian thought.

We must examine the causality or relation between education and globalisation before constructing a methodology examining it, with particular interest in science education. This article accords with Dale and Robertson's (2002) view regarding globalisation as a nonhomogeneous force and views it as an effect of the flows of capitalism (Deleuze & Guattari, 1977, 1987). The goal is to provide a methodological outline examining this nonhomogeneous force in the educational field in all its entangled manifestations. Globalisation demonstrates a characteristic application of force, although situated non-causally, which is self-similar in whichever field it emerges—the features of marketisation and economics, and the specific flows of capitalism and its "smooth spaces" (Deleuze & Guattari, 1987, pp. 490–492). Despite specific forms and manifestations appearing in differing ways, a similar form of economisation or 'business' persists in the various fields, to be elaborated upon with the discussion of the quasi-self-similar fractal. At least three businesses, instances of globalisation or influences from multiple fields can thus be examined with the methodology this article attempts to construct: 1) *the learning business* or how psychology, testing, and other knowledge forms regarding learning are commercialised and deployed in the educational field as new interventions teachers can apply, thereby promoting and testing learning among pupils; 2) *the teaching business* or how new forms of didactics, classroom management, and other disciplinary/managerial tools are introduced to both faculty and students, which again appear in a commercialised form, as products or practices school leaders can invest in or guide their teaching staff towards; and 3) *the empire-building business* or how schools are oriented towards producing specific kinds of morality among their charges who will grow up to be citizens engineered for a globalised world's new markets and economic demands. Value-laden words—innovation, creativity, sustainable development—have manifested internationally across curricula and national educational goals, as well as numerous other places where an emphasis on justifying educational objectives is observed.

What do I mean by the term *empire-building business*? This article is situated within a historical concept of education as a necessary element in constructing the nation-state (Boli, Ramirez, & Meyer, 1985; Foucault, 1995; Meyer, Ramirez, & Soysal, 1992). I present specific reasoning advocating for *empire-building* instead of *nation-state building* or similar terms. Emphasising empire over state is based upon two Foucauldian notions: 1) that schooling appeared in different manifestations before the political nation-state emerged and thus should always be seen in the transformative light of earlier

historical forms (Foucault, 1995, 2009); and 2) the role that Roman culture, civitas, and the empire/republic played in transforming conceptualisations of the modern era's nation-states (Foucault, 1990) must be considered. Before the specific form of compulsory schooling arose late in the 18th century in Western civilization, school was the place in which children were trained and where new citizens, soldiers, judges, policemen and politicians were educated. In other words, youth were educated to fulfil vital functions as adults within the empire/state. This aspect of schooling has not disappeared from contemporary society, and my article posits that as globalisation and the higher education arms race has increased in momentum, this specific educational component has come to dominate the educational sphere or field.

An emphasis on the empire-building business aspect of schools and schooling means examining schools' historical structural role in society, and the contribution both schools and curriculum make in creating a specific type of desirable citizen (Bang & Valero, in press; Popkewitz, 2004a, 2004b, 2008). This desirable citizen is moulded to a specific mode of thought and acquiring of a particular kind of knowledge in accordance with the morality and governance of the respective nations. This examination is done from both within and without the educational field, looking at how other fields perceive school and schooling, and how the economics field influences that of education.

The empire-building aspect is perhaps the more hidden part of the triad of businesses noted above. Not in a 'deep sense' but more easily 'overlooked' because of its obviousness unless an educational researcher is equipped with an expanded notion of field. The emphasis of the empire-building aspect results from its specific relation to the scientific field, which will be examined below. These 'three new business' aspects regarding schooling could similarly be understood as neoliberal aspects (Bourdieu & Wacquant, 1999), but this article refrains from going down that avenue. The contemporary conceptualisation of neoliberalism in research is posited in a specific historic condition regarding capitalism's effects but simultaneously invokes a binary and creates a discursive formation, where neoliberalism is at the bad end of the former and often seen as a reaction from a leftist or Marxist perspective. Thus, the concept tends to polarise, invoking a certain politicisation, making neoliberalism dismissible as a mere political concept. Conceptualising the process as an empire-building business is therefore an attempt to fertilise the conceptualisation of neoliberalism extended by Bourdieu and Wacquant (1999) with Foucault's use of the biopolitical concept and his contextualisation of specific neoliberal forms (Foucault, 2010). The empire-building business concept in effect tries to capture and enunciate a specific neoliberal form directed towards morality and civitas that is both contemporary and capitalistic yet historic in its roots.

How might educational research analyse schooling's structural role and the empire-building business? First, one needs to establish an encounter of thought between two concepts: Bourdieu's *field* and Foucault's *discursive fields*, thereby expanding Bourdieu's notion of various doxa into a virtual field in its own right.

A field by any other name

In the Bourdieuian sense, a field is an epistemological construct supplying the researcher with an abstract yet very material gaze upon various institutions and social spaces: for example, bureaucratic institutions (Bourdieu, 1999), a particular neighbourhood (Bourdieu, 2005), or elite schools (Bourdieu, 1998b). Bourdieu proposes the following relation: [(habitus)(capital)] + field = practice (Bourdieu, 1984), not as an exact equation but as a relation between his key concepts for understanding social spaces. Grasping the concept of field means using a new epistemological relational lens:

> Thinking in terms of a field requires a conversion of one's entire usual vision of the social world, a vision which is interested only in those things which are visible: in the individual, the *ens realissimum* to which a sort of fundamental ideological interest

> attaches us; in the group, which is only apparently defined by mere relations, temporary or enduring, informal or institutionalized, obtaining between its members; or even in relations understood as *interactions*, that is, as concretely enacted intersubjective relations. (Bourdieu, 1990a , p. 192, italics in the original)

In other words, in employing the concept of field, one must step away from the typical way of representing the real or the milieu. To gaze upon social spaces with a notion of field is to perceive in terms of positional relations. Bourdieu employs various analogies to describe a field: a soccer game (Bourdieu, 1990b), a force field (Bourdieu, 1984, 2005; Bourdieu & Wacquant, 1992) or a field from physics (Bourdieu, 1998a, pp. 19–30). All of them share a relational aspect and the dynamic yet structural view of the positioning of agents within a field, due to its specific laws. A notion of field also entails, however, other critical concepts of Bourdieu without which the concept of field is merely a hollow, structural 'shell' housing the concepts of habitus and capital. The combined concepts of habitus and capital form a relational unit describing the positioning, potential, and perception of the field agents and without those two concepts, akin to position and charge in the electrical field, one cannot gauge an agent's position, practices and strategies within the space.

The Bourdieuian notion of field, however, raises some difficulties, which Thomson articulated as covering at least three issues (Grenfell, 2008): 1) *quantity*—how many fields are there in the social space?; 2) *quality/demarcation*—what distinguish the fields from each other and when does a field 'end'?; and 3) *correspondence/entanglement*—how are the fields connected, and what happens between them, both from the agents' perspectives and also regarding the forms of capital and power?

The last challenge to discuss regarding the notion of field is the notion of the *field of power*. We turn to Bourdieu, who offers different descriptions. In one of his clarifying essays, in which he tries to address misunderstandings and critical remarks, he describes the field of power in the following terms, exemplified by the literary field:

> For example, if it's true that the literary field is, like every field, the locus of power relationships (and of struggles aiming to transform or maintain them), the fact remains that the power relations which are imposed on all agents entering the field—and which weigh with a particular brutality on the new entrants—assume a special form. (Bourdieu, 1990a, p. 141)

This reading is crucial for interpreting Bourdieu's concept of power and for this article's encounter with Foucault. In short, every field is one of power, operating as a sort of background field. In addition, when considering the economical—also one of power—its nature and impact both fractalise and distort the field of power in lesser fields, which often assume economic or capitalist forms. Thus capitalism, as the superior force of de-territorialization, has *de-territorialised* other fields, recoding them into distorted versions of itself (Deleuze & Guattari, 1977). Bourdieu analysed the educational field in numerous instances (Bourdieu, 1988, 1998b; Bourdieu & Passeron, 1990), and his conclusions indicated the educational field and the institutions therein tend to promote a specific kind of reproduction and inequality in terms of cultural capital (Bourdieu, 1998b; Bourdieu & Passeron, 1990). Foucault enunciated a similar claim regarding governments and the growth of biopolitics, which suddenly saw a new form of measurement arise that transformed other fields (Foucault, 2010).

To examine the three issues raised by Thomson (Grenfell, 2008), this article suggests employing a new image of thought employing quasi-self-similar fractal—an image better suited to clarifying the issues and understanding the transversals and influences among multiple fields. This new image of thought is an attempt to represent the strange universality or 'universal mechanisms of fields' one encounters, when investigating both historical and contemporary fields:

> Whenever one studies a new field, whether it be the field of philology in the 19th century, contemporary fashion, or religion in the Middle Ages, one discovers specific properties that are peculiar to that field, at the same time as one pushes forward our

> knowledge of the universal mechanisms of fields, which are specified in terms of secondary variables. (Bourdieu, 1993, p. 72)

Before we can examine the new image of thought of the quasi-self-similar, however, Bourdieu's concept of field must be fertilised by an encounter with Foucault's concept of discursive fields.

An encounter with Foucault's virtual field

Bourdieu often has iterated that some fields dominate or at the very least exert extensive influence over other related fields: his specific examples are the economic field and the scientific field (Bourdieu, 2000b, 2004, 2005). To trace the influence and domination of fields in the realm of doxa (Bourdieu, 1990b), one benefits from using the Foucauldian methodology of archaeology in an encounter with Bourdieu's concepts, thus supplying Bourdieu's field with a kind of virtual field (Bang, 2014; Deleuze, 1986). In other words, Foucault shows us how doxa are related to the field of power.

A Foucauldian field is not the same as a Bourdieuian field, and Foucault does not present a clearly demarcated sociological concept for the idea as does Bourdieu, who emphasises sociological factors whereas Foucault's emphasis is on discourse and practice (Foucault, 1972, 1995). In the early years of his writing, Foucault focused on discursive and nondiscursive formations in a field of nondiscursive practices (Foucault, 1972 , p. 75)—the archaeological part of his methodology. Deleuze's reading of Foucault (1986) enunciates three topographies of Foucault: 1) the archive; 2) the map; and 3) the diagram. The archive and the map are the vertical and horizontal horizons of Foucault's discursive fields and belong to Foucault—the archivist. In this encounter, they are seen as the depth and the spread of discursive and nondiscursive practices in the various fields. The diagram is "the thought from the outside" (Deleuze,1986, p. 43), an abstract machine, connecting both vertical and horizontal horizons with the notion of power; in this encounter, it is connected to the field of power.

> The *diagram* is no longer an auditory or visual archive but a map, a cartography that is coextensive with the whole social field. It is an abstract machine. It is defined by its informal functions and matter, and in terms of form, makes no distinction between content and expression, a discursive formation and a nondiscursive formation. It is a machine that is almost blind and mute, even though it makes others see and speak. (Deleuze, 1986, p. 34)

How shall we approach these discursive fields, and how can they be applied to the Bourdieuian concept of field? Both Foucault and Bourdieu agree that language is a form of practice (Bourdieu, 1977, 1990a, 1990b; Foucault, 1972, 1995), and such practices 'do' something both different and alike across fields. By establishing an encounter of thought of the Foucauldian terms *discursive* and *nondiscursive* formations as a concept for explaining discursive field structures, together with the Bourdieuian notion of fields, we derive an additional discursive dimension of fields, the mechanics of an abstract machine, but one crucial to an epistemology able to trace the correspondence and entanglements across fields. The final missing piece of the Foucauldian encounter, and the epistemology constructed to investigate the relation between the scientific and educational fields, is a specification of the Foucauldian term *discursive families* (Deleuze, 1986; Foucault, 1970, 1972), which are part of conceptualising discursive formations. In investigating correspondence, entanglement, or transversal transformed practices, and discursive formations, this article proposes the relation rationality ⌠ irrationality as a construct to help us trace those 'movements' in the scientific field, in so far as the term is constructed for this occasion and specifically relates to the fields this article explores. In analysing specific historical families of discourse in the scientific field, there seemed to be 'emerging' clusters of particular intersecting discourses, containing notions of causality and a specific 'inner logic' (scientific doxa). The rationalities' birthplace is arbitrary. They do not

share *one* point of origin but are instead the products of specific, historically contingent discursive possibilities; this could also be seen as a specific expansion of Bourdieu and Wacquant's notion of 'carriers' (1999). The moment a discursive formation manifests itself or is born into, for instance, the scientific field, it is sedimented or manifested in practices and nondiscursive formations within the field; simultaneously, an opportunity arises in other fields to pick up and transform both practice and discursive formations.

The encounter of thought now established, we can move forward into this new image of thought employing quasi-self-similar fractals to understand the influence multiple fields exert upon each other and how such images fertilise Bourdieu's and Foucault's conceptualisations.

Overlapping fields—learning from fractals

What is a fractal, and why is it appropriate as an image of thought for a Bourdieuian and Foucauldian understanding of multiple fields?

Figure 1 shows a fractal image. If you 'zoom' in and out of the image, you will see exact self-similarity, meaning that all the small, closed geometric shapes are similar to the larger ones. Fractals can be found in nature's leaves, snow crystals, and other instances of reproduction. Fractals are continuous but cannot be mathematically differentiated (Mandelbrot, 1983).

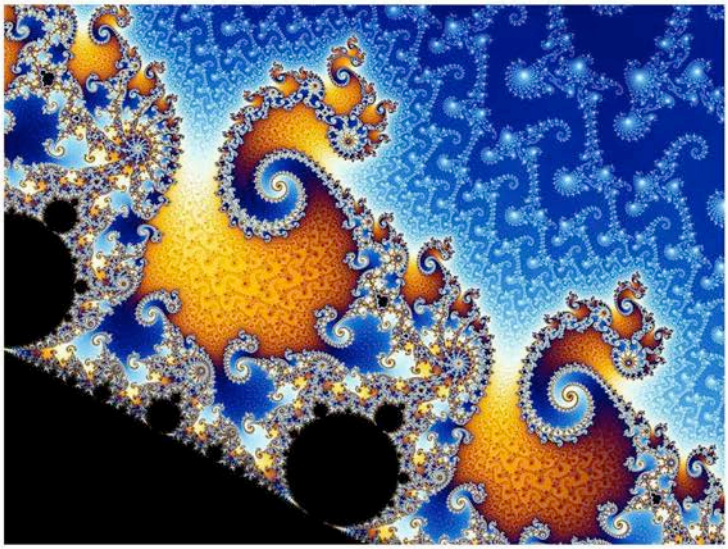

Figure 1. A Mandelbrot exact self-similar-fractal

The specific fractals most similar to Bourdieu's and Foucault's notions of field are, from my perspective, *quasi-self-similar fractals*, which are *almost* analogous in their reproduction and endless enumeration; small differences of distortion manifest in each geometric instance within the fractal's different levels and result from the manifestation on the plane of immanence, and thus are not in a plane of transcendence or 'pure thought'. Deleuze and Guattari (1987), producing a similar line of thought, noted the exact-self-similar fractal image as one of a smooth space and there is always a multiplicity and movement between smooth space and striated space. Smooth space is mentioned here because it belongs to manifestations (de-territorialisation) of the decoded flows of late capitalism

(smooth capital). Quasi-self-similar fractals can serve as images of thought regarding fields in several productive ways and thus clarify the three issues raised by Thomson:

1. In a clear image, they depict the role the economic field plays in connection to all other fields and how it is shaping and recoding the 'lesser' fields according to its own inner logic, which is in line with Bourdieu's perspective on the economic field's overarching role (Bourdieu, 1990a, 2005); meaning, in even the smallest fields, an economy of sorts occurs naturally due to the smooth space of capitalism mentioned above and its territorialisation/de-territorialisation;
2. The quasi-self-similar fractals show how every field is different and yet similar to some extent, and how each field's scale can be very different and embedded within one another's—yet characterised by an embeddedness demarcated by the specific topology of the field in question and the rules therein. The infinite continuity of the fractal's reproduction thus clearly solves the issue of field quantity—there is an infinite or perhaps an infinitesimal amount of both fields and subfields!;
3. Regarding the notion of the field of power: the similarity between the geometric figures' shapes reveals that in the image of thought, every field demarcation is one of a specific locus of power—thus, every field is one of power, with its own specific rationalities, practices and dispositions to establish a power-relational structure within the field or subfield itself.

This also helps us understand where the field's demarcation line is located; although being always a continuous, immeasurable fractal image and barrier, it is precisely where the exercise and practice of power changes form and appearance. In other words, when the forms and 'value' of capital change, one has entered a new field or subfield. This demarcation can be found on both a large scale with particular fields (e.g., entering a successful old-law firm) but similarly on a very small and intimate scale (e.g., entering a specific club in the workplace, belonging to a specific part of an underground political movement, and so forth). The similarity and endless enumeration, or differentiation without differentiation, can also be seen as a contemporary effect of economisation or capitalism, akin to the special hegemony proposed by Laclau and Mouffe (2001), a hegemony of capitalism operationalising a special kind of differentiation;

4. The last problem this figure tries to address is the role of correspondence and how an agent can travel between fields, akin to 'carriers' (Bourdieu & Wacquant, 1999 , p. 50), and how specific fields are connected and exert an entangling influence over each other.

Take, for example, the 'travelling agent' and how it can be seen in the quasi-self-similar fractal image: An agent entering a new field and exerting influence in that space is, in a way, a change in the fractal equation, and its habitus/capital can be shown in the factor's scale or the 'zoom', which should be added to the overall field enumeration. Thus, if a major agent with considerable economic, symbolic and cultural capital enters a specific field, its different forms of capital will be transferred therein, according to the rules and regulations within the specific field. The impact on the field's shape/fractal will therefore be extensive and will alter the field's geometric shape (zooming up or down). An agent entering a field is thus always a factor of quantity and intensity, akin to the charge of its capital and habitus. It is almost as if the agent, in this image of thought, is a smooth space or fractal him/herself, which posits itself relationally in a new quasi-self-similar fractal (or the fractal boundary of one), which again changes/distorts due to the newly inserted agent/fractal.

One must constantly keep in mind a certain unique historicity specific to the connected fields when analysing fields and transversals, and in accord with both Bourdieu's and Foucault's notion of history:

> I believe indeed that there are no transhistoric laws of the relations between fields, that we must investigate each historical case separately. Obviously, in advanced capitalist societies, it would be difficult to maintain that the economic field does not exercise

> especially powerful determinations. But should we for that reason admit the postulate of its (universal) "determination in the last instance"? (Bourdieu & Wacquant, 1992, p. 109)

The expansion of the notion of multiple fields thus should be observed in the above 'cautionary' words from Bourdieu. This image of thought of the quasi-self-similar fractal is an attempt to expand Bourdieu's and Wacquant's notion of transposition (Bourdieu, 1998b; Bourdieu & Wacquant, 1999) and to move it into an encounter with a Foucauldian understanding of discursive fields (1972) to show how different discursive fields exert influence upon each other. The above image of the quasi-self-similar fractals is not meant to introduce a systemic view regarding fields or assert that an agent is simply 'a particle' or enumeration. Every field is one of struggle, and the image of the fractals should be understood as an attempt to represent the multiplicity among multiple fields, not to reduce it to systemic notions. To show how the new image of thought of quasi-self-similar fractals is meant to aid our understanding of fields, allow a demonstration of an example of such a transformation of a rationality and how it discursively manifests in the educational field's institutional practices; accordingly, we are now ready to embark on investigating the empire-building business or the historical conditions of possibility for specific practices within schools through the discursive field.

A practice transformation and a discursive field manifestation—*homo empiricus*/the man of science

A sample taken from an interview:

> LB: I have had some other students talking about the x's and y's (the students following the science subjects or scientific subject courses) … do you think they are much different from you? (*I have had other students explain that difference and was trying to explore that discourse*).
>
> Cathrine, Megan, and Julie: Yes (in unison, they laugh).
>
> LB: Yes? How are they different?
>
> Megan: Well … they think it is fun to sit and do math in the breaks … and find some equation or … (Megan sighs deeply) … but come on …
>
> Cathrine: It is in fact … it is more on a human level. I think … I can get really irritated at them sometimes …
>
> Julie: They are so nerdy …
>
> Cathrine: Yes … and they are just … I don't think they are as … I think they have pulled down their blinds (specific Danish saying*: skyklapper på,* meaning they have closed their minds) … also, I don't think they are as tolerant towards other people …
>
> LB: No?
>
> Cathrine: Where I think that we … have [learned] some human values, who, like, make us … tolerate more people and accept people … and … like … understand …
>
> Megan: But there is also that issue … that we get to see things … from more perspectives …
>
> Cathrine: Yes.
>
> Megan: And that is what we are trained in …
>
> Cathrine: Yes.

> Megan: They just need to find that specific equivalence (mathematical equal sign) (specific Danish term: *facit der*) … so if there is anyone … that's how I think it fits together … so if there is anyone they don't like (makes a sound indicating a no … or a bullying gesture) … where we … I mean …
>
> LB: Do you also think they are like that at the university?
>
> Megan: Yes … I think I maybe am just generalising a bit …
>
> LB: Yes?
>
> Megan: Because … I don't know.

The above excerpt exemplifies how the scientific field influences the educational field through a specific rationality and practice, being a portion drawn from a larger study of empirical material gathered during spring 2013 via a series of interviews I conducted with students aged 17–19 years in upper secondary education, dubbed Gymnasium or Den almene studentereksamen (STX) in Denmark (equivalent to the final three years of high school in other countries). It was conducted as a group interview in which I explored the young women's general opinions, the surface of discourse, the topic of natural science, and how they perceived other students who followed a course of study in the natural sciences.

Our conversation focused on the educational field's discursive level and exemplifies discourses the students 'evoke' or manifest when discussing fellow students studying science at school. The view on practices thus comes from the discursive formations and rationalities, not from practicum observations, in this specific case. The science students (the x's and y's) also were interviewed as part of the larger study, and they give a similar account, but from a different position, regarding the specific scientific habitus and discursive formation analysed in the excerpt above.

Two findings from the interview are crucial in explaining why an entangled framework based on Bourdieu and Foucault supports analysing discursive fields in educational studies. First, the students described their positions taken towards the science students, including how they seem somehow different on a 'human level', and how they (the nonscientists or humanists) perceive themselves as trained to be more humane and to view things from multiple perspectives. This provides, indirectly, insight into both the discourse formations related to the general scientist and what kind of person s/he is—that is, highlighting the scientific mindset's rationality. The first finding regarding the rationality or discourse formation is constructed as 'the Man of Science' (and thus implying a specific construction between gender and science), which should be seen directly linked to the Foucauldian methodological part. The epistemological gaze does not regard students' opinions as their 'own', but rather as being part of a discursive formation. In this specific instance, it relates to the rationality and specific discursive family regarding the notion of the Man of Science, and what kind of person 'he' is and his characteristics (basically stereotypes regarding scientists).

The second finding concerns the humanities students' descriptions of the science students' practices or habitus, allowing for an indirect glimpse at what a science 'nerd' is 'required' to possess or show, when they practise a specific scientific habitus. Doing 'math in the breaks' or 'thinking there is an equivalence [equal sign] to everything' are the elements these students recall as being major behavioural differences between themselves and the science students. In other words, through the discursive positioning of one habitus, we glimpse another through the discursive formations drawn in to rationalise a field position. Via these discourse formations, we indirectly get a general understanding of how the educational field creates and fosters specific scientific habitus (Bourdieu, 2004) required in the scientific field. The special adaptation of habitus is here dubbed *Homo empiricus*, threading together with Bourdieu's notions of *Homo economicus* (Bourdieu, 2005) and *Homo academicus* (Bourdieu, 1988), and Foucault's *Homo oeconomicus* (Foucault, 2010, p. 268).

The label *Homo empiricus* was not constructed arbitrarily but rather to emphasise two points. First, concerning the relation between science and the empire-building business, we note the field of science is perceived as one of progress and growth, a 'sacred field' of pure knowledge, with its nurturing crucial for nation-states' progress, although other fields may generate greater profit or 'market-value'. Progress in engineering, medicine, physics and so forth all contribute to the scientific field; the discursive formations of the 'serious sciences' dominate and transform both pseudo-science and religion, and even create a special rational form of biopolitics (Foucault, 2010). Thus, the scientific habitus is of special interest in promoting or educating society in fields extending beyond science. Second, *Homo empiricus* emphasises how the scientific habitus brings with it specific, correct methods in data collection and rational measurement, and objectification, which accords with Daston and Galison's research regarding the history of objectivation (2007). The empirical part of the scientific habitus takes on a doxa of its own and is intrinsic in understanding the scientist, and how s/he is positioned vis-à-vis other academic fields. The habitus *Homo empiricus*, constructed and 'born' in the scientific field, undergoes a different yet similar birth and manifestation in the educational field.

We must keep three things in mind regarding the notion of *Homo empiricus* and its entanglement with the Man of Science: 1) *Homo empiricus*, in a way, is itself a manifestation of the Man of Science's rational nature and vice versa. The scientific habitus *Homo empiricus* and the discursive formations surrounding it mean the Man of Science is thus entangled in a relation, in which one is the manifestation and precondition of the other; 2) its connection with the Man of Science entangles the notion in both educational and scientific fields. The Man of Science's rationality becomes a goal or discourse for people to either strive towards or position against. Science education's quality moves in degrees of purity towards the Man of Science, and it aims to produce subjects according to that rationality and subsequent habitus; 3) this scientific habitus is purposely constructed through curricula and intentions directed from outside the educational field—in short, schooling's empire-building business aspect. When the Man of Science's rationality and its subsequent habitus *Homo empiricus* manifests simultaneously in fields outside scientific and educational ones, it is incorporated into policies and similar nondiscursive formations and practices, where it acts as a benchmark by which to measure science education. This is exemplified in the project's frame, from which the above-referenced interview excerpt was taken.

The methodology and the fractal image of entangled, multiple, semi-autonomous fields, the notion of scientific habitus or *Homo empiricus*, and the rationality of the Man of Science are thus constructed and extended in this article as a means to examine the empire-building business in the education field, with special emphasis on the natural sciences. The analysis should be understood as a timely and contextual conceptualisation in that regard.

The empire strikes back?

The empire-building business is a historical yet also a contemporary phenomenon, and only through employing a contemporary methodology can educational researchers investigate such an entity. The encounter of thought forwarded in this article should be seen as both an act of *timely resistance* and a modern examination of the empire-building business in education. Foucault's conceptualisations help Bourdieu and vice versa, both theorists having resistance at the centre of their writings (Bourdieu, 2000a; Foucault, 2003). The French marriage is not arbitrary but a movement of thought between two thinkers who expressed great concern regarding the matter of the state and the subject, and how capitalism changes the way our society governs its people. The methodology proposed is thus an attempt to strike back at the empire-building business in the educational field with a fresh image of thought, a new diagram offering researchers a unique way to examine fractal pockets of resistance and the nature of distortion within particular fields. Deleuze describes this opportunity of struggle:

> Thus there is no diagram that does not also include, besides the points which it connects up, certain relatively free or unbound points, points of creativity, change and resistance, and it is perhaps with these that we ought to begin in order to understand the whole picture.
>
> It is on the basis of the "struggles" of each age, and the style of these struggles, that we can understand the succession of diagrams or the way in which they become linked up again above and beyond the discontinuities. (Deleuze, 1986, p. 44)

As such, this contribution to the Bourdieu special issue is an attempt to create a new diagram, through the powerful image of thought by employing the application of fractals. It is my hope that other educational researchers will change it, modify it and expose its limitations and flaws, so that our collective methodologies can improve on and better illustrate capitalism's effects on society in general, and in particular, on the empire-building business that remains hard at work in the field of education.

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References

Bang, L. (2014). Between the cat and the principle: An encounter between Foucault's and Bourdieu's conceptualisations of power. *Power and Education, 6*(1), 18–31.

Bang, L., & Valero, P. (in press). Chasing the chimera's tails: An analysis of interest in science. In T. S. Popkewitz (Ed.), *The "reason" of schooling. Historizing curriculum studies, pedagogy and teacher education*. New York, NY: Routledge.

Boli, J., Ramirez, F. O., & Meyer, J. W. (1985). Explaining the origins and expansion of mass education. *Comparative Education Review, 29*(2), 145–170.

Bourdieu, P. (1977). *Outline of a theory of practice*. Cambridge, England: Cambridge University Press.

Bourdieu, P. (1983). The field of cultural production, or: The economic world reversed. *Poetics, 12*(4), 311–356.

Bourdieu, P. (1984). *Distinction: A social critique of the judgement of taste* (N. Richard, Trans.). London, England: Routledge.

Bourdieu, P. (1988). *Homo academicus*. Cambridge, England: Polity Press.

Bourdieu, P. (1990a). *In other words: Essays towards a reflexive sociology*. Stanford, CA: Stanford University Press.

Bourdieu, P. (1990b). *The logic of practice* (R. Nice, Trans.). Cambridge, England: Polity Press.

Bourdieu, P. (1993). *Sociology in question*. London, England: Sage.

Bourdieu, P. (1994). Rethinking the state: Genesis and structure of the bureaucratic field. *Sociological theory, 12*(1), 1–18.

Bourdieu, P. (1998a). *Practical reason: On the theory of action*. Stanford, CA: Stanford University Press.

Bourdieu, P. (1998b). *The state nobility: Elite schools in the field of power*. Stanford, CA: Stanford University Press.

Bourdieu, P. (1999). Rethinking the state: Genesis and structure of the bureaucratic field. In G. Steinmetz (Ed.), *State/culture: State-formation after the cultural tur* (pp. 53–75). New York, NY: Cornell University Press.

Bourdieu, P. (2000a). *Acts of resistance: Against the new myths of our time*. Cambridge, England: Taylor & Francis.

Bourdieu, P. (2000b). *Pascalian meditations*. Stanford, CA: Stanford University Press.

Bourdieu, P. (2004). *Science of science and reflexivity*. Cambridge, England: Polity Press.

Bourdieu, P. (2005). *The social structures of the economy*. Cambridge, England: Polity Press.

Bourdieu, P., & Passeron, J.-C. (1990). *Reproduction in education, society and culture*. Cambridge, England: SAGE.

Bourdieu, P., & Wacquant, L. (1999). On the cunning of imperialist reason. *Theory, Culture & Society, 16*(1), 41–58.

Bourdieu, P., & Wacquant, L. J. D. (1992). *An invitation to reflexive sociology*. Chicago, IL: University of Chicago Press.

Dale, R., & Robertson, S. L. (2002). The varying effects of regional organizations as subjects of globalization of education. *Comparative education review, 46*(1), 10–36.

Daston, L. J., & Galison, P. (2007). *Objectivity*. Brooklyn, NY: Zone Books.

Deleuze, G. (1986). *Foucault* (S. Hand, Trans.; 2006 ed.). London, England: The Athlone Press.

Deleuze, G. (1994). *Difference and repetition*. London, England: Contiuum Group.

Deleuze, G., & Guattari, F. (1977). *Anti-oedipus: Capitalism and schizophrenia*. New York, NY: Viking Press.

Deleuze, G., & Guattari, F. (1987). *A thousand plateaus: Capitalism and schizophrenia*. Minneapolis: University of Minnesota Press.

Foucault, M. (1970). *The order of things. An archaeology of the human sciences* (2nd ed.). New York, NY: Routledge.

Foucault, M. (1972). *Archaeology of knowledge* (A. M. S. Smith, Trans.; 1st English ed.). London, England: Routledge.

Foucault, M. (1990). *The history of sexuality, vol. 1: An introduction*. New York, NY: Random House.

Foucault, M. (1995). *Discipline and punish: The birth of the prison* (A. Sheridan, Trans.). New York, NY: Random House.

Foucault, M. (2003). *"Society must be defended": Lectures at the Collège de France, 1975–1976* (D. Macey, Trans.). London, England: Penguin Books.

Foucault, M. (2009). *Security, territory, population: Lectures at the Collège de France, 1977–1978* (Vol. 4). New York, NY: Palgrave Macmillan.

Foucault, M. (2010). *The birth of biopolitics: Lectures at the Collège De France, 1978–1979* (G. Burcell, Trans.). New York, NY: Palgrave Macmillan.

Grenfell, M. (2008). *Pierre Bourdieu: Key concepts*. Durham, NC: Acumen Publishers.

Laclau, E., & Mouffe, C. (2001). *Hegemony and socialist strategy: Towards a radical democratic politics*. London, England: Verso Books.

Mandelbrot, B. B. (1983). *The fractal geometry of nature*. New York, NY: Times Books.

Meyer, J. W., Ramirez, F. O., & Soysal, Y. N. (1992). World expansion of mass education, 1870–1980. *Sociology of Education, 65*(2), 128–149.

Popkewitz, T. S. (2004a). The alchemy of the mathematics curriculum: Inscriptions and the fabrication of the child. *American Educational Research Journal, 41*(1), 3–34.

Popkewitz, T. S. (2004b). School subjects, the politics of knowledge, and the projects of intellectuals in change. In P. Valero & R. Zevenbergen (Eds.), *Researching the socio-political dimensions of mathematics education: Issues of power in theory and methodology* (pp. 251–267). Boston, MA: Kluwer Academic .

Popkewitz, T. S. (2008). *Cosmopolitanism and the age of school reform: Science, education, and making society by making the child*. New York, NY: Routledge.

[∞-1] A MINOR KODA - INSIDE THE EVENT HORIZON

"The ending is nearer than you think, and it is already written.

All that we have left to choose is the correct moment to begin." (Moore & Lloyd, 2009, V for Vendetta)

My soul's escaping through this asshole that is gaping
A black hole that I'm swallowing this track whole
With a pack torn of paper
But I'm not taking no crap, ho
Here I go down the back pole
And I'm changing back into that old maniac in fact there it go
Trying to dip through the back door retreating cause everybody knows…

(Eminem, 2013a, Asshole)

[∞-1,∞] THE INFINITE END

This is the End of Days within the labyrinth, the last confrontation and judgement. The rapture of Science already transported the Structural Villain away, only the Hero` is left in the Black Hole and there is no escape. He at last faces the great adversary, standing on the flight deck of the Nostromo. Here, the minotaur could finally be given full birth, escaping through his chest. It now grows in front of him, grows into the frail man with the golden teeth, the vassal of Human Lank Nil. The weapons assembled and vivisected produce a specific outcome - the minotaur is banished, the patient zero have been ejected into the Void, and the Hero' waits here for his eventual demise as the Nostromo rushes toward the center of the Event Horizon. But nothing escapes the black hole, not time, space, or light, and the hero is stuck here in an infinite demise, an infinite destruction.

> I'm beginning to feel like a Rap God, Rap God
> All my people from the front to the back nod, back nod
> The way I'm racing around the track, call me Nascar, Nascar
> Dale Earnhardt of the trailer park, the White Trash God
> Kneel before General Zod this planet's Krypton, no Asgard, Asgard.
>
> (Eminem, 2013d, Rap God)

> Every consciousness pursues its own death, every love-passion its own end, attracted by a black hole, and all the black holes resonate together.(…) Subjectification carries desire to such a point of excess and unloosening that it must either annihilate itself in a black hole or change planes.(Deleuze & Guattari, 1987, pp. 133-134)

[∞,∞+1] THE IMPLOSION AT THE END - A MINOR BANG THEORY

And thus concludes the nonsensical yarn of the Structural Hero, the sensical report of the You, the I, the We, the He and the Us. The Structural Hero dies with a whimper, a minor Structural Bang. The fractured I can close the book, close the experience and say, “Now I am wiser”, “Now I am more than I was before”, “Now I understand more”…

Every instance of learning ends in destruction, a fall, a great implosion and reassembly. Nothing will and must never stay the same – everything keeps unfolding “So it goes”. What is left of the experience? Only the 3rd kind of knowledge lives on, and that is yet to be seen if something of it arises from the destruction of the Structural Hero. This is not a Big Bang, a Big Glamorous Ending, only the minor ending of the Bang theory can survive the implosion. Only the Monsters, Villains, and the Principle of the Cat will perhaps become eternal. They were full of joy, passion and have a hope to survive the Structural Hero, the deus ex machina of this thesis.

LITERATURE LIST

Agamben, G. (1998). *Homo sacer: Sovereign power and bare life*. Stanford: Stanford University Press.

Althusser, L. (1976). *Essays in self-criticism*. London: Schocken Books.

Bacciagaluppi, G., & Valentini, A. (2009). *Quantum Theory at the Crossroads*. Cambridge: Cambridge University Press.

Berlyne, D. E. (1949). 'Interest'as a psychological concept. *British Journal of Psychology. General Section, 39*(4), 184-195.

Berlyne, D. E. (1965). *Structure and direction in thinking*. England, Oxford: John Wiley.

Biesta, G. (2005). Against learning. Reclaiming a language for education in an age of learning. *Nordisk Pædagogik, 25*(1), 54-55.

Bourdieu, P. (1977). *Outline of a Theory of Practice*. Cambridge, UK: Cambridge University Press.

Bourdieu, P. (1984). *Distinction: A Social Critique of the Judgement of Taste* (N. Richard, Trans.). London: Routledge.

Bourdieu, P. (1988). *Homo academicus*. Cambridge: Polity Press.

Bourdieu, P. (1990). *In other words: essays towards a reflexive sociology*. Stanford, CA: Stanford University Press.

Bourdieu, P. (1998). *The state nobility: elite schools in the field of power*. Stanford, CA: Stanford University Press.

Bourdieu, P. (1999). *The weight of the world: Social suffering in contemporary society*: Stanford University Press.

Bourdieu, P. (2000). *Pascalian meditations*. Stanford, CA: Stanford University Press.

Bourdieu, P. (2003). Participant Objectivation*. *Journal of the Royal Anthropological Institute, 9*(2), 281-294.

Bourdieu, P. (2004). *Science of science and reflexivity*. Cambridge, UK: Polity Press.

Bourdieu, P. (2005). *The social structures of the economy*. Cambridge, UK: Polity Press.

Bowden, S. (2011). *The Priority of Events: Deleuze's Logic of Sense*. Edinburgh: Edinburgh University Press.

Buñuel, L. (Writer). (1929). Un Chien Andalou [Silent film]. In L. Buñuel & P. Braunberger (Producer): Les Grand Films.

Carroll, L. (1917). *Through the looking glass: And what Alice found there*. London: Rand, McNally.

Cassidy, D. C. (1992). *Uncertainty. The life and science of Werner Heisenberg* (Vol. 1). New York: Freeman Publisher.

Cassidy, D. C. (2000). A historical perspective on Copenhagen. *Physics today, 53*(7), 28-32. doi: 10.1063/1.1292472

Chambers, R. W. (1895). *The King in Yellow*. USA: F. Tennyson Neely.

Cohen, L. (1992). Anthem. On *The Future*. USA: Columbia.

Collins, L. M., & Lanza, S. T. (2010). *Latent class and latent transition analysis*. New Jersey: John Wiley & Sons Inc.

Conrad, J. (1990). *Heart of Darkness and Other Tales*. New York: Oxford University Press.

Daniels, M. (Writer) & G. Roddenberry (Director). (1966). The Man Trap. In G. Roddenberry (Producer), *Star Trek: The Original Series*. USA: CBS Television Distribution.

DeLanda, M. (2013). *Intensive science and virtual philosophy*. London: Bloomsbury Academic.

Deleuze, G. (1986). *Foucault* (S. Hand, Trans. 2006 ed.). London: The Athlone Press.

Deleuze, G. (1988). *Spinoza: practical philosophy*. San Francisco: City Lights Books.

Deleuze, G. (1990). *Expressionism in philosophy: Spinoza*. New York: Zone Books.

Deleuze, G. (1994). *Difference and repetition* (P. Patton, Trans.). London: Continuum International Publishing Group.

Deleuze, G. (1995). *Negotiations 1972-1990*. New York: Columbia University Press.

Deleuze, G. (2003). *Francis Bacon: the logic of sensation* (D. W. Smith, Trans.). New York: Continuum.

Deleuze, G. (2004a). *Desert Islands: And Other Texts, 1953--1974*. New York: Semiotext.

Deleuze, G. (2004b). *The logic of sense* (M. Lester, Trans.). London: Bloomsbury Academic.

Deleuze, G. (2006). *The Fold: Leibniz and the Baroque*. New York: Continuum.

Deleuze, G. (2007). *Two Regimes of Madness: Texts and Interviews 1975–1995* (A. H. a. M. Taormina, Trans.). New York: Semiotext.

Deleuze, G., & Guattari, F. (1983). *Anti-Oedipus : capitalism and schizophrenia*. Minneapolis: University of Minnesota Press.

Deleuze, G., & Guattari, F. (1987). *A thousand plateaus : capitalism and schizophrenia*. Minneapolis: University of Minnesota Press.

Deleuze, G., & Guattari, F. (1994). *What is philosophy?* New York: Columbia University Press.

Dewey, J. (1938). *Experience & Education*. New York: Touchstone.

Dickens, C. (1983). *David Copperfield*. New York: Oxford University Press.

Dohn, N. B., & Højgaard, T. (2014). Evaluering af dele af projektet STAR: Styrkelse af rekruttering til naturvidenskabelige uddannelser *IMFUFA tekster* (Vol. 497). Roskilde University: Roskilde University.

Dunkel, H. B. (1970). *Herbart and Herbartianism: An educational ghost story*. Chicago: University of Chicago Press.

Dylan, B. (1965). Ballad of a Thin Man. On *Highway 61 Revisited*. New York: Columbia.

Eco, U. (2001). *Foucault's pendulum*. London: Vintage.

Eminem. (2002). Lose Yourself. On *Music from and Inspired by the Motion Picture 8 Mile and Curtain Call*. Los Angeles: Shady, Aftermath, Interscope.

Eminem. (2013a). Asshole. On *The Marshall Mathers LP 2*. USA: Shady, Aftermath, Interscope.

Eminem. (2013b). Evil Twin. On *The Marshall Mathers LP 2*. USA: Shady, Aftermath, Interscope.

Eminem. (2013c). The Monster. On *The Marshall Mathers LP 2*. USA: Shady, Aftermath, Interscope.

Eminem. (2013d). Rap God. On *The Marshal Mathers LP 2*. USA: Aftermath, Shady, Interscope.

Foucault, M. (1970). *The order of things. An archaeology of the human sciences* (2nd edition ed.). New York: Routledge.

Foucault, M. (1972). *Archaeology of Knowledge* (A. M. S. Smith, Trans. 1st english ed.). London: Routledge.

Foucault, M. (1977). Theatrum philosophicum *Language, counter-memory, practice: Selected essays and interviews* (pp. 165-196). Ithaca, N.Y.: Cornell University Press

Foucault, M. (1986). *Death and the Labyrinth: The world of Raymond Roussel* (C. Ruas, Trans.). New York: Doubleday & Company, Inc.

Foucault, M. (1994). *Aesthetics, method, and epistemology* (R. H. a. others, Trans. J. Faubion Ed. Vol. 2). New York: Penguin Books.

Foucault, M. (2000). *Power* (R. H. a. others, Trans. Vol. 3). New York: Penguin Books.

Foucault, M. (2003). *" Society Must Be Defended": Lectures at the Collège de France, 1975-1976* (D. Macey, Trans.). New York: Picador.

Gagliardo, J. G. (1969). *From pariah to patriot: the changing image of the German peason, 1770-1840*. Lexington: University Press of Kentucky.

Gardner, P. L. (1975a). Attitude measurement, a critique of some recent research. *Education Research, 7*, 101-109.

Gardner, P. L. (1975b). Scales and Statistics. *Review of Educational Research, 45*(1), 43-57.

Geda, C. (Writer). (1999). Meltdown, *Batman Beyond*. USA: The WB Television Network.

Guattari, F. (1984). *Molecular Revolution: Psychiatri and politics* (R. Sheed, Trans.). London: Penguin Books.

Guattari, F. (2008). *Chaosophy: Texts and Interviews 1972--1977* (S. Lotringer Ed.). Los Angeles: Semiotext.

Haynes, T. (Writer). (2012). The Reichenbach Fall. In E. Cameron (Producer), *Sherlock*. England: BBC Television.

Hegel, G. W. F. (2010). *The Science of Logic*. Cambridge: Cambridge University Press.

Heisenberg, W. (1949). *The physical principles of the quantum theory* (C. E. F. C. Hoyt, Trans.). Chicago: Dover Publications.

Johns, G., & Kreisberg, A. (Writers). (2014). Pilot. In G. Berlanti, A. Kreisberg & G. Johns (Producer), *The Flash*. British Columbia, Canada: Warner Bros. Television.

Jung, C. G. (1968). *Aion: Researches in the Phenomenology of the Self*: Princeton University Press.

Kierkegaard, S. (1996). *Papers and journals: a selection* (A. Hannay, Trans.). London: Penguin.

Krapp, A., & Prenzel, M. (2011). Research on Interest in Science: Theories, methods and findings. *International Journal of Science Education, 33*(1), 23.

Kubrick, S. (Writer). (1968). 2001: A Space Odyssey. In S. Kubrick (Producer). USA: Metro-Goldwyn-Mayer.

Lange, T., Johannesen, K., & Henriksen, T. H. (2010). De unges veje gennem uddannelsessystemet i Nordjylland (pp. 103). Region Nordjylland: Region Nordjylland.

Lee, S., & Ditko, S. (1963). *The Amazing Spider-Man #1* (Vol. 1). New York: Marvel Comics.

Lindley, D. (2008). *Uncertainty: Einstein, Heisenberg, Bohr, and the struggle for the soul of science*: Anchor.

Lovecraft, H. P. (2002). *The Call of Cthulu and Other Weird Stories*. London: Penguin Books Ltd. .

Macherey, P. (1998). *In a materialist way: Selected essays.* New York: Verso.

Marquand, R. (Writer). (1983). Return of the Jedi. In H. Kazanjian (Producer): 20th Century Fox.

Marx, K. (2010). *Volume 1: Karl Marx 1835-43* Marx & Engels Collected Work, J. Cohen, M. Cornforth & M. Dobb (Eds.), *Marx & Engels Collected Work*

Marx, K., & Engels, F. (2010). *Volume 5: Marx and Engels 1845-1847* Vol. 5. J. Cohen, M. Cornforth & M. Dobb (Eds.), *Marx & Engels Collected Works*

McGuigan, P. (Writer). (2010). The Great Game. In S. Moffat (Producer), *Sherlock Holmes*. UK: BBC.

Melton, J. V. H. (2002). *Absolutism and the eighteenth-century origins of compulsory schooling in Prussia and Austria*. Cambridge: Cambridge University Press.

Merton, R. K. (1968a). The Matthew effect in science. *Science, 159*(3810), 56-63.

Merton, R. K. (1968b). *Social theory and social structure*. New York: Macmillan.

Merton, R. K. (1988). The Matthew effect in science, II: Cumulative advantage and the symbolism of intellectual property. *isis, 79*(4), 606-623.

Moore, A., & Gibbons, A. (2005). *Absolute Watchmen*. New York: Titan.

Moore, A., & Lloyd, D. (2009). *V for Vendetta*. New York: DC Comics.

Nietzsche, F. (1996). *Human, All Too Human* (R. J. Hollingdale, Trans.). Cambridge: Cambridge University Press.

Nietzsche, F. (2001). *The Gay Science* Cambridge: University of Cambridge.

Nietzsche, F. (2002). *Beyond Good and Evil*. Cambridge: Cambridge University Press.

Nietzsche, F. (2005). *The Anti-Christ, Ecce Homo, Twilight of the Idols: And Other Writings*: Cambridge University Press.

Nolan, C. (Writer). (2005). Batman Begins. In C. Roven, E. Thomas & L. Franco (Producer). USA: Warner Bros. Pictures.

Nolan, C. (Writer). (2008). The Dark Knight. In C. Nolan (Producer). USA: Warner Bros. Pictures.

O'Neill, J. (2004). *The poverty of postmodernism*. New York: Routledge.

Osborne, J., & Dillon, J. (2008). Science Education in Europe: Critical Reflections. A report to the Nuffield Foundation. London: Nuffield Foundation.

Pais, A. (1982). *Subtle is the Lord. The science and the life of Albert Einstein* (Vol. 1). Oxford: Oxford University Press.

Pais, A. (1991). *Niels Bohr's times, in physics, philosophy, and polity* (Vol. 1). Oxford: Clarendon Press.

Palahniuk, C. (2006). *Fight Club*. London: Vintage Books.

Parr, A. (Ed.). (2010). *The Deleuze Dictionary*. Edinburgh: Edinburgh University Press.

Pelbart, P. P. (2013). *Cartography of Exhaustion - Nihilism inside out*. Sao Paola: n-1 publications.

Plato. (1892). *The Dialogues of Plato, vol. 1* (B. Jowett, Trans. 3rd ed. Vol. 1). Oxford: Oxford University Press.

Popkewitz, T. S. (2005). *Inventing the modern self and John Dewey : modernities and the traveling of pragmatism in education*. New York: Palgrave Macmillan.

Popkewitz, T. S. (2008). *Cosmopolitanism and the age of school reform : science, education, and making society by making the child*. New York: Routledge.

Rainey, L., Poggi, C., & Wittman, L. (Eds.). (2009). *Futurism: An Anthology*. London: Yale University Press.

Rammstein. (2001). Sonne. On *Mutter*. France: Motor Music.

Rammstein. (2006). Reise, Reise. On *Reise, Reise*. Malaga, Spain: Motor Music, Republic Records.

Rice, A. (2010). *Interview with the Vampire*. London: Sphere.

Roddenberry, G. (Writer). (1987). Star Trek: The next generation. USA: CBS Television Distribution.

Rorty, R. (1992). *The linguistic turn: Essays in philosophical method*. Chicago: University of Chicago Press.

Schleunes, K. A. (1979). Enlightenment, Reform, Reaction: The Schooling Revolution in Prussia. *Central European History, 12*(4), 315-342. doi: 10.1017/S0008938900022457

Schrödinger, E. (1935). Present status of quantum mechanics. *Die Naturwissenschaften, 23*(48), 26.

Schrödinger, E. (1992). *What is life?: With mind and matter and autobiographical sketches*: Cambridge University Press.

Scofield, C. I. (2006). *The Scofield Study Bible: English Standard Version*: Oxford University Press.

Scott, R. (Writer). (1982). Blade Runner. In M. Deeley (Producer). United States: Warner Bros.

Shelley, M. (2003). *Frankenstein: Or, the Modern Prometheus*. London: Penguin Books Ltd.

Sjøberg, S., & Schreiner, C. (2010). The ROSE project: An overview and key findings. *Oslo: University of Oslo*.

Smith, D. W. (2005). The Inverse Side of the Structure Žižek on Deleuze on Lacan. *Criticism, 46*(4), 635-650.

Smith, D. W., & Somers-Hall, H. (Eds.). (2012). *The Cambridge Companion to Deleuze*. New York: Cambridge University Press.

Spinoza, B. D. (1996). *Ethics* (E. Curley, Trans.). London: Penguin Group.

Stolze, T. (1998). Deleuze and Althusser: Flirting with structuralism. *Rethinking Marxism, 10*(3), 51-63.

Tyack, D. B., & Cuban, L. (1995). *Tinkering toward utopia: A century of public school reform*. Boston: Harvard University Press.

Voltaire, F. (1996). *The complete works of Voltaire* (Vol. 48). Paris: Institut et Musée Voltaire.

Vonnegut, K. (2000). *Slaughterhouse-five, or The Children's Crusade - A Duty-dance with Death* (1991 ed.). London: Vintage.

Wachowskis, T. (Writer). (2003). The Matrix Revolutions. In J. Silver (Producer). Australia: Warner Bros. Pictires.

Waits, T. (2002). All The World is Green. On *Blood Money*. U.S: Anti.

Whale, J. (Writer). (1931). Frankenstein. In C. J. Laemmle (Producer). USA: Universal Pictures.

Zizek, S. (2012). *Organs without bodies: On Deleuze and consequences*. London: Routledge.

ENDNOTES

[i] The reference to an investigation of surfaces, and what a 'surface' is, is a reference to Gilles Deleuze's book on Foucault (Deleuze, 1986), Foucault's methodological approach (Foucault, 1972) and the overall investigation and approach in this thesis. It is thus a specific structural investigation of surfaces of discourse. In other words and perhaps reductio absurdum it is an investigation of stereotypes and their relation to Becoming and Being and the metaphysical surface.

[ii] The specific capitalized concept of Thought, is a reference to Deleuze/Spinoza's ontological conceptualization of Thought as an attribute of substance. This is mentioned several places in Deleuze ouvre "*Thought is not arborescent, and the brain is not a rooted or ramified matter*" (Deleuze & Guattari, 1987, p. 15) and in Spinoza's Ethics "*Thought is an attribute of God, or God is a thinking thing*" (Spinoza, 1996, p. 33, IIP1).

[iii] The specific capitalized concept of Bodies is a reference to the Deleuzian/Spinozist/Leibnizian notion of bodies and their ontological significance (Deleuze, 1988, 1990, 2006; Spinoza, 1996).

[iv] Definition: Education is a structural attempt, within a striated space, to facilitate specific forms of Becoming to produce a specific desired form of Being consisting of particular forms of Knowing.

[v] Extension is an attribute of substance and similarly taken from the Spinoza/Deleuze conceptualization: "*Extension is an attribute of God, or God is an extended thing*" (Spinoza, 1996, p. 33, IIP2). In Deleuze extension is outside the virtual and intensive, only the BwO, body without organs 'escapes extension' in the spatial sense'. Extension is the spatio-temporal dimension or surface.

> After all, is not Spinoza's Ethics the great book of the BwO? The attributes are types or genuses of BwO's, substances, powers, zero intensities as matrices of production. The modes are everything that comes to pass: waves and vibrations, migrations, thresholds and gradients, intensities produced in a given type of substance starting from a given matrix. (Deleuze & Guattari, 1987, p. 153)

[vi] Speed is a reference to Deleuze's notion of the Event (Bowden, 2011; Deleuze, 2004b), and similarly to his reading of Spinoza where one has to arrive at the idea of God as 'quickly as possible' (Deleuze, 1990, p. 297). Speed, and the hasty jagged connections are crucial for the investigation this thesis propose, for attempting to reach the third kind of knowledge, which is similar to the way Deleuze reads the whole structure of Spinoza's *Ethics.*

> One notes the general importance of these questions of speed, slowness and haste in the development of the *Ethics*: a great relative speed is needed at first in order to arrive at God as substance; then everything broadens out and slows down, until new accelerations are produced, always at necessary moments.(Deleuze, 1988, p. 112)

[vii] The labyrinth is a reference to characteristics of the plane/field of Immanence or consistency (Deleuze & Guattari, 1987, p. 254) as a cellular, rhizomatic structure and simultaneously drawing on the mythical, stereotypical ,and literary notions of the labyrinth in conjunction with the pop analysis proposed here.

[viii] Series is a reference to structural series and the ones focused here is a series of the Science-Image and Science-Structure. These series are the singular elements in the rationalities and the discursive formations referenced to in the thesis. The series are NOT linear but develops on a jagged line.

[ix] Movement is here referenced as Deleuze's notion of movement in general. Movement is closely related to Deleuze's notion of Becoming:

> Becoming is the pure movement evident in changes *between* particular events. This is not to say that becoming represents a phase between two states, or a range of terms or states through which something might pass on its journey to another state. Rather than a product, final or interim, becoming is the very dynamism of change, situated between heterogeneous terms and tending towards no particular goalor end-state.(Parr, 2010, p. 21).

[x] The concept of vivisection refers to the particular exposing of the surface and is in line with Nietzsche use of the term and his vivisection of morality, science and so forth. Man should vivisect himself first and foremost. (Nietzsche, 2001, 2002).

[xi] Deleuze's *Chapter III The Image of Thought* in *Difference and Repetition* (Deleuze, 1994) overall inspired this particular 'critique' of the dogmatic Image of Thought connected to the Logic of Science.

"The conditions of a true critique and a true creation are the same: the destruction of an image of thought which presupposes itself and the genesis of the act of thinking in thought itself" (Deleuze, 1994)

[xii] Deleuze and Guattari defines smooth space as the place of Becoming:

> Smooth space is filled by events or haecceities, far more than by formed and perceived things. It is a space of affects, more than one of

> properties. It is haptic rather than optical perception. Whereas in the striated forms organize a matter, in the smooth materials signal forces and serve as symptoms for them. It is an intensive rather than extensive space, one of distances, not of measures and properties. Intense Spatium instead of Extensio. A Body without Organs instead of an organism and organization. Perception in it is based on symptoms and evaluations rather than measures and properties. That is why smooth space is occupied by intensities, wind and noise, forces, and sonorous and tactile qualities, as in the desert, steppe, or ice. (Deleuze & Guattari, 1987, p. 479)

[xiii] Striated space is opposite, but not opposed, to smooth space. Striated space is described by Deleuze and Guattari as:

> "One of the fundamental tasks of the State is to striate the space over which it reigns, or to utilize smooth spaces as a means of communication in the service of striated space. It is a vital concern of every State not only to vanquish nomadism but to control migrations and, more generally, to establish a zone of rights over an entire "exterior," over all of the flows traversing the ecumenon. If it can help it, the State does not dissociate itself from a process of capture of flows of all kinds, populations, commodities or commerce, money or capital, etc. (Deleuze & Guattari, 1987, pp. 385-386)

[xiv] The notion of the adequate idea is a reference to Deluze's reading of Spinoza, and how one needs to form adequate ideas from common notions (Deleuze, 1990). This is opposed to a Cartesian thinking regarding the idea and Cogito. The notion of sufficient reason is a reference to Deleuze's reading of Spinoza and Leibniz, a sufficient reason is recognizing the predicate and the event, and how they are connected.

> Sufficient reason is inclusion; in other words, the identity of the event and predicate. Sufficient reason proclaims "Everything has a concept!!. Its metaphysical formulation goes as follows: "All predication is grounded in the nature of things": as logical formulation: "Every predicate is in the subject," the subject of nature of things being the notion, the concept of the things. (Deleuze, 2006, pp. 41-42)

[xv] An assemblage is a reference to Deleuze and Guattari's specific conceptualization in *A Thousand Plateaus: capitalism and schizophrenia* (Deleuze & Guattari, 1987). An assemblage is a multiplicity linking various heterogenous elements. This notion

of assemblage is similar to Spinoza's notion of bodies and how they form relations (Spinoza, 1996)

> An assemblage is precisely this increase in the dimensions of a multiplicity that necessarily changes in nature as it expands its connections. There are no points or positions in a rhizome, such as those found in a structure, tree, or root. There are only lines. (Deleuze & Guattari, 1987, p. 8)

[xvi] The notion of the Abstract Machine is explained, enunciated and developed many places in Deleuze's ouevre (Deleuze, 1986; Deleuze & Guattari, 1987). Here it is seen in the form the Diagram (Deleuze, 1986) connecting the various rationalities (discursive thread of structural elements) of the Ouroboros into a specific heterogenous configuration of Scientific Literacy, which is actualized in the discursive formation.

[xvii] Non-compossible or incompossible is a reference to Deleuze's reading of Leibniz and refers to the divergence between series

[xviii] Late capitalism is a reference to the conceptualization of capitalism by Deleuze and Guattari as flows of deterritorialization (Deleuze & Guattari, 1983)

[xix] The notion of Knowing is a reference to Deleuze's reading of Spinoza and how knowledge is seen in relation to adequate ideas and common notions. The third kind of knowledge is when one arrives at the notion of God and how everything is connected through him/nature/it. Knowing is thus seen here in various stages where the third kind of knowledge exemplify the 'highest' / 'lowest' kind, only the third kind of knowledge survives death. (Deleuze, 1990)

[xx] A simulacrum is Deleuze's specific notion of representation in relation to his overturning of Platonism. He enunciates this notion in *Difference and Repetition* (Deleuze, 1994) and in *The Logic of Sense* (Deleuze, 2004b). A simulacrum is copy of which there is no original. Every appearance is a mask.

> In order to go beyond representation, it is necessary, therefore, to undermine the primacy of the original over the copy and to promote the simulacrum, the copy for which there is no original. A key influence on Deleuze as far as the anti-representational orientation of his thought is concerned, is Friedrich Nietzsche. Nietzsche's speculations on metaphor show that there is no 'truth' behind the mask of appearances, but rather only more masks, more metaphors. Deleuze elevates this insight into something like a general metaphysical principle. For him, the world is

composed of simulacra: it is a 'swarm' of appearances.(Parr, 2010, p. 228)

[xxi] The Matthew Effect is a reference to Robert Merton' s sociological notion of The Matthew Effect, where he uses a paraphrase from the Bible, where those who have will be given more. The Matthew Effect is thus a notion regarding structural unequal distribution of wealth, knowledge, and so forth.

[xxii] Conatus here seen in line with Deleuze's reading of Spinoza's concept of Conatus connected to the power of acting in the particular mode. Conatus is an effort to augment the power of acting or to experience joyful passions.

And the conatus is the effort to experience joy, to increase the power of acting, to imagine and find that which is a cause of joy, which mains and furthers this cause; and also an effort to avert sadness, to imagine and find that which destroys the cause of sadness.(Deleuze, 1988, p. 101)

[xxiii] There a continuous Movement, not a simple opposition, between smooth and striated space, as two sides of the same coin.

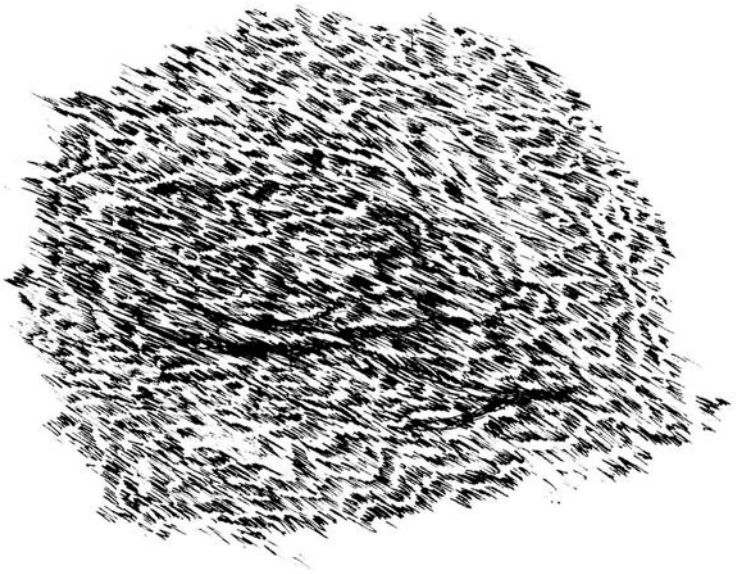
"No sooner do we note a simple opposition between the two kinds of space than we must indicate a much more complex difference by virtue of which the successive terms of the oppositions fail to coincide entirely. And no sooner have we done that than we must remind ourselves that the two spaces in fact exist only in mixture: smooth space is constantly being translated, transversed into a striated space; striated space is constantly being reversed, returned to a smooth space. (Deleuze & Guattari, 1987, p. 474)

[xxiv] On striated and smooth capital:

On the other hand, at the complementary and dominant level of integrated(or rather integrating) world capitalism, a new smooth space is produced in which capital reaches its "absolute" speed, based on machinic components rather than the human component of labor. The multinationals fabricate a kind of deterritorialized smooth space in which points of occupation as well as poles of exchange become quite independent of the classical paths to striation. What is really new are always the new forms of turnover. The present-day accelerated forms of the circulation of capital are making the distinctions between constant and variable capital, and even fixed and circulating capital, increasingly relative; the essential thing is instead the distinction between striated capital and smooth capital, and the way in which the former gives rise to the latter through complexes that cut across territories and States, and even the different types of States. (Deleuze & Guattari, 1987, p. 492)

[xxv] Bare life is here is a reference to Giorgio Agamben notion of bare life (Agamben, 1998) and how biopower acts and regulates the notion of life within striated space. What is drawn upon here is similar line of thought between Agamben, Deleuze and Foucaults notion of power and how it regulates life, and what life 'is'. In other words the regulation of bare life and what life 'is' happens within science and its education.

[xxvi] To gaze upon structural series, as here in comics, is similar to the gaze the main character and time-traveller, Billy, possess in Kurt Vonnegut's *Slaughterhouse-five* (Vonnegut, 2000). A gaze seeing and continually developing future and past, everything becomes connected, the sense-event, the now, is compressed future and past in the same singularity.



SUMMARY

The problematic this thesis investigates, through a specific kind of structuralism derived from a reading of Michel Foucault, Pierre Bourdieu and Gilles Deleuze, concerns how the subject becomes a science subject and potentially a scientist, with interest and literacy in science.
The Logic of Science – a vivisection of monsters is thus an exploration of Being and Becoming in relation to Science and its Education. The investigation has been derived from, in, and connected to the Youth-to-Youth Project, a regional bridge building project in Northern Jutland in Denmark.
The Youth-to-Youth Project (2011-2015) attempts to facilitate contact and provide a different kind of counselling and guidance between youths and youths who are 'one step ahead' in their educational trajectory. The meetings between the youths are both social and science subject oriented, and the intention is to establish a longitudinal mentor relationship in upper primary and lower secondary school (specifically 8-9th grade in primary school and 2-3g in the gymnasium) potentially easing the mobility between the respective educational institutions.
The articles and the compiled wrapping is an attempt to reach a new conceptualization, a new Image of Thought in the Deleuzian sense, of Science and its Education and the process of individuation connected to this. The results within the dissertation are thus the very frame, methodology, and reconceptualization of key notions in science education research. The outlined new line of thought is brought to an encounter with the problematic regarding youths and their educational trajectory in Science and its Education. The approaches towards counselling and youth to youth relations in the Youth-to-Youth Project have thus been informed by the investigation and methodology of the dissertation. It has been an attempt to setup an encounter to potentially reach smooth space where the usual restrictions and regulations of education and counselling are temporarily absolved.
The form of the dissertation reflects the content, which turns the very structure and synopsis of the dissertation into a jagged labyrinthine line. The structure thus mimics the theoretical and ontological presuppositions of the dissertation. There is a deliberate attempt to evoke a certain kind of nonsense, a certain kind of confusion, and nonlinearity in the reading of the dissertation. This contribution of this dissertation is thus overall the construction of a new analytic, through a reading of Deleuze, Foucault and Bourdieu, which has the aim of overturning the dogmatic view of education and freeing educational thought from inadequate conceptualizations and stale knowledge.

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