The Neurobiopolitics of Global Consciousness

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> Neuroscientists say that by peering inside your head they can tell whether you identify more strongly with J.K. Rowling s Harry Potter, say, than with J.R.R. Tolkien s Frodo. A beverage company can choose one new juice or soda over another based on which flavour trips the brain s reward circuitry. It s conceivable that movies and TV programmes will be vetted before their release by brain-imaging companies.[1]

In their well known study *Empire* (2000), social theorists Antonio Negri and Michael Hardt elucidate what philosopher Michel Foucault had already made explicit in the last chapter of his *The Will To Knowledge* (1976): they once again reiterate and delineate, in Section 1:2 of their text, the different and evolutionary consequences of the disciplinary society and the society of control (to use Foucauldian parlance). On the one hand, the disciplinary society is constructed through a dissemination of social command by diffuse networks of machinic assemblages*f*, to borrow a term from the cultural theorist Gilles Deleuze, that regulate each*f* subject s customs, habits and productive practice.[2] Extensive culture (characterised by stable Euclidean geometries, the assembly line, arboreal classification systems such as the taxonomic classification systems of Carl Linnaeus) operates upon the subject from the outside, specifically restricting his or her movements and choices along pre-set paths. Disciplinarity fixed individuals within institutions but did not succeed in consuming them completely in the rhythm of productive practices and productive socialisation: it did not reach the point of permeating entirely the consciousness and bodies of individuals*f*[3]. On the other hand, the society of control operates within the domain of intensive cultural apparati characterised by the Riemannian

spaces, rhizomatic logics and folded temporality induced by the multiplicity of flows that characterise our global world post-internet.[4]

According to Negri and Hardt, this transition from a disciplinary society to the society of control involves the emergence of what they refer to as biopower*ƒ*, which regulates social life from within. By contrast, when power becomes entirely biopolitical, the whole social body is comprised by power s machinery and developed in its virtuality. This relationship is open, qualitative, and affective. Society, subsumed within a power that reaches down to the ganglia of the social structure and its processes of development, reacts like a single body. Power is thus expressed as a control that extends throughout the depths of the consciousness and bodies of the population ¡ and at the same time across the entirety of social relations*ƒ*[5].

Since 1987, the field of neuroscience has seen the emergence of Neural Darwinism and Neural Constructivism , powerful new theoretic tools that have profound implications for how biopolitical systems might instantiate themselves in the neurobiological substrate of the individuals that comprise the social body. Utilising these concepts, I would like to explore the possible mechanism and sites through which we might understand the new potential for biopower, which I am now referring to as the neurobiopolitical: the ability to sculpt the physical matter of the brain, and its abstract counterpart, the mind. I will also show how this process ultimately has very significant implications for imagination and creativity.[6]

Neural Selectionism / Neural Constructivism

Recent research in neuroscience, most notably the pioneering work of neuroscientist Jean Pierre Changeux at the Pasteur Institute in Paris, and the later assemblage and expansion of this work by biologist and Nobel laureate Gerald Edelman in San Diego into what is now referred to as Neural Darwinism or Neural Selectionism , has provided new tools with which to understand the important role played by culture in the configuration of the architecture of the central nervous system. This theory, or as it is sometimes called, the Theory of Neuronal Group Selection , has three main tenets: developmental selection , experiential selection and reentry .

Developmental selection describes the ontogeny of the embryo as an interaction between its genotype and the circumstances of its prenatal environment. Events occurring at the microscopic level, such as cell division, migration, differentiation and plastic modification, create what Edelman refers to as the primary repertoire . This term describes a dense and variable population of neurons with complex branching patterns that create extensive neural connections.[7]

Experiential selection is defined as the period just prior to birth and continuing throughout life, in which the diverse and variable population of the primary repertoire is pruned and sculpted by the environmental context to which the human being needs to adapt. Most changes, however, take place in the early years and are linked to what is referred to as neural plasticity ¡ the ability of neurons and their synapses and dendrites to adapt and change as a result of experience. Most importantly, according to Edelman,

Experiential selection does not, like natural selection in evolution, occur as a result of differential reproduction, but rather as a result of differential amplification of certain synaptic populations*ƒ*[8]. Further, those neurons, neural networks or assemblages of neurons, and their dendritic and synaptic components that are most often and intensely stimulated, will acquire more efficient means of information transmission, thus enabling them to outmanouevre those neurons and neural networks that don t. In other words, as a result of being repeatedly excited by recurrent and repetitive external stimuli, these neurons develop firing patterns that have increased efficiency and specific tuning, and as a result are therefore likely to be favoured over other neurons and networks in future encounters with this stimulus.[9]

However, neurons and neuronal networks do not fire in isolation; they are part of large complexes that are together called out by complex stimuli. They could be part of abstract assemblages of stimulation, such as a billboard one might find in Times Square in New York or Piccadilly Circus in London, with its flashing lights, smoke rings, video screen, text messages and speaking voice telling you to smoke Camel cigarettes As eminent cognitive psychobiologist D.O. Hebb has so astutely stated, Neurons that fire together wire together*ƒ*. They form greater firing efficiencies collectively, and form other alliances with other networks similarly excited and predisposed.

Reentry, the third part of the neural selectionist triad, allows for the synchronisation of neural events occurring in circumscribed and widely disparate areas of the brain. It plays a role in binding together these networks, some of which are broadly distributed throughout the brain, through its dynamic influences. As a result of this cooperation, even a partial trace of the original stimulus, by exciting a small number of neurons in a section of the complex web of neurons, can excite all the neurons in the network. Sharing of inputs in this manner allows for the repetitive stimulation of the network, which results in greater efficiencies for all the individuals in the whole group. It also gives the network advantages, in the competition for neural space, over other neural groups not thus stimulated.

Those neurons and neuronal groups that are less stimulated either find other targets to connect with, or undergo a mode of cell death called apoptosis: the process by which neurons that fail to find their targets degenerate and then are phagocytised (eaten up or absorbed by other neurons). In simple nervous systems, apoptosis plays a major role in pruning ¡ the least-used synaptic connections being selectively destroyed, while the most-used are retained. However, in more complex systems like the cerebral cortex of humans, it plays a minor role. ª[I]t appears that apoptosis is a more important factor in simple systems such as the spinal cord motor neurons, where about fifty percent of the neuronal population is wiped outª than in more complex systems like the primate cerebral cortex where it occurs in less than twenty percent*ƒ*[10]. In these systems, the abundance of potential sites for alternative connectivity in the cerebral cortex may alleviate the need for cell death.

So far, this is a story of pruning and subtraction. It only partly describes the data on brain development and evolution, which shows that the brain mass gets larger instead of smaller with age, and that different parts of the brain grow at different rates. Neural

Constructivism sees development as a progression in representational complexity. It appears to involve both selective elimination as well as considerable growth and elaboration.[11] Studies by Greenough and Chang[12] and Coleman et al[13] have found that the degree of correlation between the firing of groups of dendrites in the receiving part of a neuron, rather than simply the presence of activity, was essential for the production of dendritic complexity and growth. What this means is that the secondary repertoire ¡ the primary repertoire pruned by experience ¡ goes through a dynamic change in which those selected neurons undergo a further transformation. They continue to be stimulated by correlated activity, which may also correspond to correlated relationships in the real-imaginary-virtual interface, with other neurons which are coding for similar stimulation complexes; and the connectivities thereby multiply and grow (here I am using the word virtual to refer to virtual reality, not the virtual as described by Deleuze in relation to the actual, in his account of ontological parameters).

Neuralbiodiversity and Cultural Determinism

Culture is in a constant state of transformation as it responds to a changing milieu, determined by the cumulative effect of a multitude of immaterial relations that are each in a state of unrest. Each of these relations mutates within a rapidly evolving context of new possibilities ¡ for example, in relation to the speed of information transmission ¡ and develops new vocabularies and systems of meaning to accommodate those changes. Then, individually or together with the other changing relations also affected by these mutating conditions, they create new dynamic patterns of flows that impact culture. Sociological conditions, political intrigues and scandals, global economic depressions, conditions of psychological instability, historical reinvention, spiritual revivals ¡ all of these operate together to transform the context in which culture operates; and, in some cases, operate together upon culture itself. This flux creates new pressures on the system of culture, producing subsequent instabilities.

These instabilities are the result of noise produced by certain incompatibilities of coded information between the existing cultural system and the new flows of information it attempts to incorporate. To respond to this crisis of assimilation , culture creates new technologies. Here I would like to describe in detail one such technology, the optical; I confine myself to this in the interest of time and clarity, although similar changes are taking place in the auditory, kinesthetic, and tactile sensorial realms as well.

Optical technologies can be divided into two groups. First, projective creative optical technologies, examples of which are the camera obscura, camera lucida, photographic camera, stereo camera, cinema, virtual reality and, most recently, intelligent media. These devices help create the world as a projective interface to be inspected by the organic system of the eye and brain; as such, this eye-brain link produces the plastic mimetic configuration of the noumenal/phenomenal world. As is explained further in the essay, the eye-brain apparatus is a plastic and selected entity in a constant flux between being and becoming, a *being* and *becoming* that is co-evolving with the mutating conditions of the

world. It is the relation between what I term intensive technologies (discussed later in this essay), and the cultures they attempt to redefine spatially and temporally: redefinitions that lead to new forms of linkages in the tectonic substrate of culture itself. I call these linkages cultural bindings ; and it is this binding of cultural artefacts, for instance, that leads to new networks of meaning within that culture. This cultural binding leads to intensely stimulating cultural networks that, as we will see, may sculpt neural networks preferentially (I use the word intense*ƒ* here to mean a very strong stimulus, as well as one which is non-linear, folded and rhizomatic in its spatial-temporal dimension. This latter quality is what makes such stimuli powerful agents of neural excitation). It is this fundamental relation between cultural and neural networks that defines what I am calling Cultural Determinism.

The evolution of projective optical technologies has for decades inspired artists, designers and architects, who were awed by the new kinds of images and processes that these machines made possible. In her description of *La Fenêtre en Longueurƒ*, a drawing Le Corbusier made at his parents house on Lake Geneva, architectural historian and critic Beatriz Colomina states that the window glass is superimposed on a rhythmic grid that suggests a series of photographs placed next to each other in a row, or perhaps a series of stills from a movie*ƒ*[14]. This is an instance of photography and cinematography influencing the way the architect, in his desire to respond to these new optical possibilities afforded by cinematic time and space, reinvents the materials of his trade, glass and window, in a way that re-enacts and re-maps the experience of cinema onto the experience of architecture. We will see shortly the implications of this effect on other forms of visual culture, and their summated affect upon the nature of embodiment.

Invented in parallel with these projective technologies are introspective technologies. The word introspective can have psychological meanings related to the investigation of the self, as in looking into oneself or knowing oneself; but in the context of this essay, I am referring to instruments that probe the body in order to understand its own changing anatomical and physiological conditions. Introspective technologies may in the future help us to see at the functional , dynamic, synaptic and neuronal-net level, on which the effect and residue of events in real/imaginary-virtual space over time can be appreciated. This kind of brain mapping is beyond our reach today. However, recent theories that attempt to make sense of the ways the brain works have begun to leave strict hierarchical descriptions in favour of ones that are non-hierarchical.[15] For instance, neural complexity in relation to subjectivity is now being studied at the level of collectives of neural circuits that display patterns of emergence of large-scale integration.[16]

Of the many new devices invented that enable culture to visualise itself , only a few are really relevant; and these, as a result of their widespread use and dissemination, help define and optically describe that culture. Perspective was the best visual analogy with which to describe the sociological, psychological, economic, historical and spiritual conditions of the Renaissance; new media is the best way to depict those same conditions today.[17] This is not to say that one excludes the other. In fact, the genealogy of optical instrumentation is a history of one technique subsuming the qualities of its predecessors, followed by a

moment of unease in which structural rearrangement leads to a mutation in its form and operation, and then to the invention of a new device that can be adapted more adequately to the conditions at hand. We are reminded of communications theorist Marshall McLuhan s idea of remediation*f*, in which the content of any medium is always another medium.[18]

I suggest here that an analogical process of remediation is occurring in the brain as well. The co-evolutionary phenomenon I have been alluding to is more than simply a selection of neural tissues: it is an evolution of the processes through and by which they operate. Phylogenetic changes are slow changes, the result of genetic mutations:

> All the old control systems must remain in place, and the new ones with additional capacities are added on and integrated in such a way as to enhance survival. In biological evolution, genetic mutations produce new cortical areas that are like new control systems in the power plant; while the old areas continue to perform their basic functions necessary for the survival of the animal, just as the older control systems continue to sustain some of the basic functions of the power plant.[19]

Older systems of the brain form the basic foundations for the new capacities of the organ as it evolves.[20] This has been discussed earlier in the essay with regard to the primary repertoire, which is the end result of millions of years of evolution. Its variability is to a certain extent determined by all the changes recorded in the genotype, and slowly refined by natural selection.[21] I refer to this variability as *neuralbiodiversity*. This condition, hospitable to and augmented by the mechanisms of neural plasticity, enables the rapid changes of experiential selection to take place, as well as those of epigenesis ¡ the development of an individual and/or the external environment as a result of interaction between an individual s genes, external environment and internal environment.

These rapid generational changes in context of genetic drift and Baldwinian evolution (which is based on the fact of phenotypic plasticity, the ability of an organism to adapt to its environment during its lifetime, and which emphasises the fact that the sustained behaviour of a species or group can shape the evolution of that species) can become incorporated into the genome. The anthropologist Terrence Deacon delineates this as the mechanism by which we acquired language, and for which a special area of the brain was developed.[22] Deacon explores the means by which language evolved as a cultural entity. He sampled a population of humans with a variable innate capacity for the acquisition of language. As language produced real advantages, those whose brains were more receptive to the acquisition process in the end gained a selective sexual advantage, and through their descendants produced a population of what he now calls *homo symbolicus*. Similarly perhaps, new technology ¡ through creating new types of images, sounds, feelings and hapticities with intensive spatial and temporal logics ¡ has produced different forms of cultural networks and binding. In the end, using a similar logic to that of Deacon, new forms of humanity could be produced. The new habits we now see in the children of the E-generation, who appear to have multiple or split attentions, is one example of such affect.

In other words, each new generation has a living brain that has been wired and configured by its own existence within the mutating cultural landscapes in which it lives. These new conditions allow for new kinds of images, new thoughts, new ideas that are transmitted and embedded in cultural forms of representation. As such, the history of this transformed representation forms a kind of cultural memory or cultural heredity, which has its own rules and regulatory patterns of evolution, that are different but symbiotic with Darwinian evolutionary paradigms of selection, subtraction and deletion. It is a system of memory that evolves as the result of the Bergsonian mode of creative evolution , which is neither mechanical nor teleological, and does not represent evolution as conditioned by existing forces or by future aims; it is additive, and concerns the ways and means that the constantly transformed context provides a backdrop for the constant re-evaluation and reformulation of cultural ideas. These ideas are alive, but pulsate at different amplitudes and frequencies in the web of cultural meanings, depending on the ratiomatic and proportional distribution of immaterial relations that create that context.[23]

By ratiomatic , I imply that cultural meanings are virtual and in flux. I am here referring to virtual in the Deleuzian sense of a repository of possible meanings that are made actual by, for instance, the relative opposition between transcendence and immanence, this difference enabling dualistic categories, Cartesian and otherwise, to be maintained. In the context of my argument, virtual implies the set of immaterial social, political, historical, psychological, economic and spiritual relations that create the human subject s overriding context at a particular moment. The inherent virtual meanings are the results of complexes of cultural binding that create nodes of varying intensities in the networks of relations. Some of these nodes are thick and strong, while others are weak and thin. Their overall distribution in the plane of immanence is their ratiomatic identity, and it changes all the time. But subtle neural changes are continuously initiated by the variable conditions of this cultural milieu. Through its capacity to reorient and seek out alternative sites for connectivity, the brain thus sculpted is able to bind and suture itself to contextual peculiarity and difference. This cultured brain can also be properly termed the intensive brain.

In a system of network conditions that are pulsating and immanent, and therefore available only at certain times, what is present at any one moment will reflect the specific combinations of entities that are existent at the time of that reception. However, what is existent is dependent on a specific context in which these networks are embedded, and which is different for each network. Thus, each context creates a ratiomatic flow of immanent cultural meanings. This cultural memory then becomes the framework through which the cultured brain is produced. When each observer dies, those neurological changes that defined his or her experience and relationship to his specific generational moment within visual culture dies as well. Only in very unusual circumstances will these experiences find their way into the genome, as in the example of language. However, that generation s cultural effect is retained in traces within that cultural habitus , awaiting a new generation of brains on which to mould new kinds of neural relations, in the end creating new types of subjectivity. In other words, a kind of cultural somatic mnemotechny is

disseminated in forms of literature, visual art, architecture and design. Separately and together, as these practices evolve they create new forms of cultural attention.

Cultural attention delineates the subset of cultural forms and relations that call out to the developing brain, through its use of images, forms of language or social contingencies that in the end are important in the processes of sculpting the brain. It too is evolving, and becoming ever more sophisticated as its forms of spatiality and temporality become linked to ever more sophisticated forms of media. These new forms are beginning to adapt and synchronise themselves to those operating at the level of neural networks. This process is called visual and cognitive ergonomics , and will be addressed later in this essay. At the moment, it is critical to re-emphasise that this development is the result of the coincident effect of the evolution of optical and haptic projective and introspective technologies.

Recently, as a result of digital technologies, there has been a transformation of the conditions of culture itself, which has implications for the history of cultural attention. I am referring to the shift from an extensive to an intensive culture. Its precursors could be first found in earlier non-narrative film practice, exemplified by Soviet director Dziga Vertov s *Man With a Movie Camera* (1929) and Italian director Luchino Visconti s *Obsession* (1943). Film scholar Donato Totaro aptly sums it up: In the time-image, which finds its archetype in the European modernist or art film, characters find themselves in situations where they are unable to act and react in a direct, immediate way, leading to what Deleuze calls a breakdown in the sensory-motor system. The image cut off from sensory-motor links becomes a pure optical and aural image , and one that comes into relation with a virtual image, a mental or mirror image *f*[24].

No longer tethered to the restrictions of the body and its narrative context of action and perception, the time-image is free to circulate according to other possible temporalities, some of recursive feedback on the body, producing new potentials and becomings.

According to contemporary philosopher Manuel De Landa, the term extensive time

> [a]may be applied to a flow of time already divided into instants of a given extension or duration, instants which may be counted using any device capable of performing regular sequences of oscillations. These cyclic sequences may be maintained mechanically, as in old clock-works, or through the natural oscillation of atoms, as in newer versions[a][25]

Intensive time, however, is characterised by nested sequences of temporality that form complex and multiplicitous relations with each other. A good example is found in the of the genomic regulatory system described by theoretical biologist Stuart Kaufman:

> The network, in so far as it is like a computer programme at all, is like a parallel-processing network. In such networks, it is necessary to consider the simultaneous activity of all the genes at each moment as well as the temporal progression of their activity patterns. Such progressions constitute the integrated behaviours of the parallel-processing genomic regulatory system.[26]

Thus, as we learn more and more about the brain and how it works, and as we begin to apply the power of computational technologies to answer some of the questions concerning its methods, we begin to see that neuro-scientific narratives based on linear modes of explanation are giving way to non-linear descriptions.

The Phylogeny of Projective Optical Technologies

One could hypothesise that the genealogy of optical instrumentation from the Renaissance to the contemporary moment is a story that recounts the history of the changing meanings of time and space. Photography most effectively reinvents and experiments with space, while cinema, building on this spatial practice, added new ways to deal with temporality. It animated and continues to animate space. Through the techniques of analog fast-cut editing, embedding fast-forward and reverse effects into narrative, and silhouetting as a means to illustrate the past, cinema reinvented the interpretation of time. As Hungarian artist and photographer L. Moholy-Nagy remarked with regard to Vertov s *The Camera Eye* (1924):

> The combination of all these elements in their astonishing interchangeability revolutionises the customary visual as well as conceptual processes. It produces a completely new timing of perception based upon the translation of physical motion into pictorial motion, also the translation of the initial action into an objectively observable process viewed by the acting persons themselves. Though this may appear at first bewildering, one must acknowledge that a new code of space-time perception is in the making.[27]

This experimentation of cinema with time does not occur in a vacuum, but is part of a network of conditions occurring in other fields similarly affected by concepts and interests involving temporal phenomena. Marcel Proust s *º La Recherche du Temps Perdu* (In Search of Lost Time), a seven-volume semi-autobiographical novel published between 1913 and 1927, Sigmund Freud s *The Interpretation of Dreams* (1900), Albert Einstein s *Special Theory of Relativity* (1905) and his *General Theory of Relativity* (1915), and Henri Bergson s *Matter and Memory* (1896) ¡ these paradigmatic writings all dealt with different experiences and formulations of time.

The field of new media, as it grew out of cinema and television, created a digital time and space: a space and time that is now folded, intensive and rhizomatic. Powerful information and communication technologies, such as the internet, undermine serial, extensive ideas of time and space. According to information cartographers Martin Dodge and Robert Kitchen, intensive technologies disrupt traditional forms of cultural and social interactions in critical ways: they promote a mode of global culturisation at the expense of local customs and traditions; they facilitate what has been termed incidental outsiderness*ƒ*, meaning that people live in multiple locations; and they create an alternative sense of identity, one that is fluid, mobile and disembodied. Thus, community that had formerly been dictated by factors of presence and place is now formulated on the basis of interests rather than on location*ƒ*[28].

But these are not the only effects. In each case, these network relations leak out of the specificity of optical media into design, fashion and architecture; and, in the end, they radically alter the visual and haptic landscape. Can anyone imagine the folded, wandering, gestural movements of the Guggenheim Bilboa without Computer Assisted Design programmes, or the idea of the rhizome of Gilles Deleuze without the Minitel? The same visual landscape that, as we will see later, will help select the brain and affect identity. Linked together, these technologies create parallel systems of temporality that simultaneously manifest in time and space, like the genetic regulatory system or the model of the brain using the process of reentry , broadly defined as the synchronisation of neural events occurring in circumscribed and widely disparate areas of the brain.

Photographic spatiality, disrupted, linear and non-linear cinematic time and space, and digital, co-extensive time and space are all now folded together through the transductive force of binary code, which is assimilative. Remediation itself cannot be seen as anything but nomadic, non-linear and recursive. One media does not flow directly into another in a linear and positivist way, but is a series of jolts, digressions, regressions, informal mixings and bricolage. The material specificity of modernism has relinquished its hold on the imagination in today s world of pervasive symbiotic systems characteristic of the postmodern condition . The result is a grand tapestry of time and space that has resulted in new combinatory possibilities and, by extension, new possibilities for thought and creativity. As these nested relations redefine objects and images, they create landscapes of meaning; these visual ensembles are sampled and processed by the intensive brain.

Brain / Mind / World

The complexities under discussion here are precisely defined by philosophers of science Franciso J. Varela and Evan Thompson:

> The nervous system, the body and the environment are highly structured dynamical systems, coupled to each other on multiple levels. Because they are so thoroughly enmeshed ¡ biologically, ecologically and socially ¡ brain, body and environment seem better conceived of as mutually embedding systems than as externally and internally located to produce (via emergence as upwards causation) global organism-environment processes, which in turn may affect (via downward causation) their constituent elements.[29]

The genealogic relations of optical technologies, both projective and introspective, contain a number of meta-genealogic relations that influence the physical constituents of the instruments themselves, how they are made, the images they produce, and the effect these have on the brain and mind. I am referring to a number of processes categorised as visual and cognitive ergonomics [30]. These two terms refer to the way that technology, combining the knowledge of neuroscience and physiological psychology with the advanced application and utilisation capabilities of computing and recent advances in special effects,

has created visual images that are more powerful then naturally occurring ones, with more enhanced potential for first calling out, and then selecting, the nervous system.

These processes employ and utilise sophisticated fields of what urbanist and theorist of technology Paul Virilio calls phatic signifiers*ƒ*. The word phatic*ƒ* shares the same root as emphatic*ƒ* (Gk. *emphanein*, to exhibit/display): it means something that forces you to look at it.

> The phatic image ¡ a targeted image that forces you to look and holds your attention ¡ is not only a pure product of photographic and cinematic focusing. More importantly it is the result of an ever-brighter illumination, of the intensity of its definition, singling out brighter only specific areas, the context mostly disappearing into a blur.[31]

I use the expression fields of phatic signifiers*ƒ* to stress that these stimuli are linked up in large conglomerates of stimulation. Think for a moment of branding . The brand is only one part of large landscape of interconnected signifiers. Visual and cognitive ergonomics has been instrumental in the production of this branded environment. It refers to an evolution of these practices as they develop in the real/virtual interface as well as the world of bodily experience. The dialogue of optical instrumentation, neurophysiologic research and, more recently, advertising and computerised special effects, has impacted the configuration of visual space in which brands are embedded. The visual landscape has become more textual, and thereby more comprehensible, to an intensive brain that has undergone analogous, although idiosyncratic, changes consistent with its own material substance, its convoluted gyri and sulci consisting of millions of neurons, glia and blood vessels. As a result of experiential selection, new types of neuronal configurations leading to new patterns of neuronal discharge have emerged, reflective of this evolving visual space and time.

Phatic stimuli are produced according to the rules of visual and cognitive ergonomics, and as such have greater attention-grabbing qualities than those stimuli not so engineered. The development of these stimuli traces a history of increasing sophistication and simulation between them. This history is punctuated by moments of competition with each other for the brain s attention, followed by moments of cooperation when certain of these stimuli link up to form networks of stimuli, giving them emergent abilities far greater then they had before, in their isolated states. What emerges is an ecology of phatic forms, the human brain being its interface.

The neuro-anatomical and neuro-physiological condition of the living brain reflects its epigenetic experience. Epigenesis involves the processes by which genetically prescribed forms are altered by interaction with their environment, be it pre-, peri- or post-natal. The conditions of the developing brain, just like the conditions of the world, create specific environments that affect populations of neurons in specific ways that have crucial consequences for its neural architecture. That experience, having been recently dominated by the phatically charged, artificially constructed, cultural domains into which it is born, will

reflect a condition generated by intensive non-organic fields of stimulation. (As mentioned earlier in this essay, one could make a similar argument for other sensorial domains.) This condition is one in which naturally derived, organic stimuli and signs, such as trees or our own naturally conditioned feelings, have difficulty competing with phatic entities for the mind s attention. The story of Thomas in my essay Blow-up: Photography, Cinema and the Brain*ƒ* is about this problem.[32]

If one superimposes the effect of global capitalism on this perceptual system, one begins to understand its staggering proportions; for it has the potential of producing and disseminating these stimuli worldwide, and to sometimes bizarre excess. Just think of the McDonalds brand, or the power of CNN. These highly engineered sign systems are distributed worldwide with incredible intensity. They have, in fact, become new media objects, according to cultural theorist and sociologist Celia Lury. A key theme in her analysis is the idea that the brand acts in the market like the interface of a computer: it is a mobile, dynamic and responsive framing of communication*ƒ*[33]. She adds: Central to the interactivity of the brand are certain practices in marketing which function in an analogous way to programming techniques in both broadcasting and computing. The most significant example is the feedback loop^a many marketing practices act like feedback loops of a computer programme*ƒ*[34]. Products differentiate according to complex open autopoeitic systems ¡ self-limiting, self-generating, self-organising, self-maintaining and self-perpetuating (much like the cell) ¡ and through practices like marketing mix , with its model of the 4 Ps : product, price, place/distribution and promotion. Consumer surveys probe user desires, needs and wants, and link these to the use of the product as a marketing tool; this data enables the producers to finally create a kind of super-sized, *über* meta-object, a phatically compelling entity that is constantly becoming as it competes in a field of similarly differentiating meta-objects for the observer s attention.

The brand progresses or emerges in time in a series of loops, an ongoing process of (product) differentiation and (brand) integration. It thus comprises a dynamic sequence or series of loops that entangle the consumer*ƒ*, Lury concludes.[35] Brands also form corporative relations with other brands. For instance, the Coca Cola, Disney and Mars Corporations have joined up to form networks of brands that interconnect both synchronously (they all occupy one space simultaneously and react in a dynamic and non-linear fashion to create super-sized desire) and diachronously (they link to the history of other advertising campaigns in which, separately or together, they attempt to influence choice, perhaps in the parents of their target group, young children; this represents a kind of internal marketing in which the brand influences new consumers, children, by appealing to the nostalgia of the parent).

Brands are a distinctive form of phatic signifiers, particularly when they are produced with the use of special effects, or when they are embedded as products used in popular movies. They become attentionally intensified when they are linked up to global campaigns in which they participate in other global phenomena, such as the global flows of money, people, ideas, raw materials; and through which they interact with local food, languages and

cultural customs. These emerging properties, as they are expressed in the global context, can compete effectively for the attention of the global brain.

In a brain that has been selected for through the operation of neural Darwinistic and neural constructivist pressures, the spatial configurations of neurons and networks and their non-linear, dynamic neural signatures manifest as synchronous oscillatory potentials; they reflect the influence of this complex, competing, artificially created network of phatic signifiers that dominate the contemporary visual landscape. Drawing attention to these processes of binding and dispersal, I propose that as the systems of technical/cultural mediation become increasingly more folded, rhizomatic and cognitively ergonomic, they evolve to more closely approximate the conditions of temporal transaction that sculpt the intensive brain.

I would also hypothesise that there exists an envelope of possible formulas of output from the brain, a kind of virtual potential in the Deleuzian sense. As intensive culture evolves into more complex formations, it produces new dispositions that, when selected and coded by the brain, unlock that potential.

The brain is a becoming machine. The paradigms of neural plasticity and neural Darwinism provide the crucial frame for its continual renewal ¡ but also perhaps for its eventual subjugationª

NOTES

1. Melanie Wells. In Search of the Buy Button*ƒ*. In *Forbes Magazine* (1 September 2003), pp. 62-70.
2. But the first zone of the power centre is always defined by the State apparatus, which is the assemblage, that effectuates the abstract machine of molar overcoding: the second is defined in the molecular fabric immersing this assemblage; the third by the abstract machine of mutation, flows, and quanta*ƒ*. Gilles Deleuze and Felix Guattari, *A Thousand Plateaus* (Continuum, 1988, New York) p. 227.
3. Michael Hardt and Antonio Negri. *Empire* (Harvard University Press, 2000, Cambridge).
4. Ibid., p. 23. Power is now exercised through machines that directly organise the brains (in communication systems, information networks, etc.) and bodies (welfare systems, monitored activities) toward a state of autonomous alienation from the sense of life and the desire for creativity*ƒ*.
5. Ibid., p. 24.
6. Ibid., p. 33. The communication industries integrate the imaginary and the symbolic with the biopolitical fabric, not merely putting them at the service of power but actually integrating them into its very functioning*ƒ*.
7. Gerald Edelman. *The Remembered Present* (Basic Books, 1989, New York), p. 45.
8. Ibid., p. 46.
9. From that process of competitive selection in the primary repertoire of cell groups, which is a process fundamentally based on variability, correlation, and connective re-entry, a secondary repertoire of neuronal groups will emerge. They will form a new representational map. The neuronal groups of this second repertoire, that is, of the newly formed map or network, will subsequently respond better to the individual stimuli that formed it. Further, the network as a whole will recognise those stimuli by responding to them categorically. Thus, by the selective process, the secondary network will have become a more effective

representational and classifying device for perception, memory and behavior than the original, primary repertoire of cell groups*ƒ*. See Joaquin M. Fuster, *Cortex and Mind: Unifying Cognition* (Oxford University Press, 2003), p. 38.

10. A central hypothesis underlying remediation and enrichment programmes is that the brain is more malleable during infancy and early childhood than later in life. This malleability leads to an increased capacity for learning, which in turn provides an opportunity for the improvement of cerebral functioning that cannot be reproduced to the same extent or with the same ease later in life. This property of the immature brain is referred to as neural plasticity*ƒ*. See Peter R. Huttenlocher, *Neural Plasticity* (Harvard University Press, 2002, Cambridge), p. 53.
11. S.R. Quartz and Terrence J. Sejnowski. The Neural Basis of Cognitive Development: A Constructivist Manifesto*ƒ*. In *Behavioral and Brain Sciences* 20 (4), pp. 537-96.
12. W.T. Greenough and F.L. Chang. Dendritic Pattern Formation Involves Both Oriented Regression and Oriented Growth in the Barrels of Mouse Somatosensor Cortex*ƒ*. In *Brain Research* 471, pp. 148-52.
13. P.D. Coleman et al. Spatial Sampling by Dendritic Trees in Visual Cortex*ƒ*. In *Brain Research* 214, pp. 1-21.
14. Beatriz Colomina. *Privacy and Publicity, Modern Architecture as Mass Media* (MIT Press, 1998, Cambridge), p. 139.
15. Varela, F.J. et al. The Brainweb: Phase Synchronisation and Large Scale Integration*ƒ*. In Nature Reviews, *Neuroscience* 2, pp. 229-39 (2001).
16. M. Le van Quyen. Disentangling the Dynamic Core: A Research Programme for Neurodynamics at the Large Scale*ƒ*. In *Biological Research* 36, pp. 67-88 (2003).
17. Bolter and Guisin s theory of remediation proposes that the history of media is a complex process in which all media, including new media, depend upon older media and are in a constant dialectic with them. Digital media are in the process of representing older media in a whole range of ways, some more direct and transparent than others. At the same time, older media are refashioning themselves by absorbing, repurposing and incorporating digital technologies*ƒ*. In (eds.) Lister, Martin et al, *New Media: A Critical Introduction* (Routledge, 2003, London), p. 55.
18. Ibid., p. 78. So, for McLuhan, the importance of a medium (seen as a bodily extension) is not just a matter of a limb or anatomical system being physically extended (as in the hammer-as-tool sense). It is also a matter of altering the ratio between the range of human senses (sight, hearing, touch, smell), and this has implications for our mental functions (having ideas, perceptions, emotions, experiences, etc.)*ƒ*.
19. John Morgan Allman. Evolving Brains*ƒ* (*Scientific American* Library Series, 1999, New York), p. 41.
20. There are, grossly speaking, two kinds of nervous system organisations that are important to understanding how consciousness evolved[a] The first is the brain stem together with the limbic (hedonic) system, the system concerned with appetite, sexual and consummatory behaviour and evolved defensive behaviour patterns. It is a value system; it is extensively connected to many different body organs, the endocrine system and autonomic nervous system[a] It will come as no surprise to learn that the circuits in this limbic-brain stem system are often arranged in loops, that they respond relatively slowly (in periods of seconds to months), and do not consist of detailed maps. They have been selected during evolution to match the body, not to match large numbers of unanticipated signals form the outside world. These systems evolved early to take care of bodily functions; they are systems of the interior*ƒ*. See Gerald Edelman, Consciousness: The Remembered Present*ƒ*, in (eds.) Sporns, Olof and Giulio Tononi,

Selectionism and the Brain (Academic Press, 1994), p. 111.

21. Personal conversation with Gerald Edelman.
22. Selection pressures affecting language must be considered as nested within one another to the extent that language evolution is nested in biological evolution. On the human side of this equation, the processing demands of symbolic reference, symbolic combination and symbolic communication in real-time provide novel selection pressures affecting the brain and vocal tract. As the language-mediated niche (the symbolic cultural environment) became more and more ubiquitous in human prehistory, these selection pressures would have become correspondingly more important and powerful, producing evolutionary changes in these structures in response. On the language side of this equation, the human-derived requirements of learnability, automatisability, and maintaining consistency with the constraints of symbolic reference provide selection pressures that affect language structures*ƒ*. See Terrence Deacon, Multilevel Selection and Language Evolution*ƒ*, in (eds.) Weber, Bruce H. and David Depew, *Evolution and Learning: The Baldwin Effect Reconsidered* (MIT Press, 2003, Cambridge).
23. Very different, in our opinion, is the kind of definition which befits the sciences of life. There is no manifestation of life that does not contain, in rudimentary state, either latent or potential ¡ the essential characters of most other manifestations. The difference is in the proportions. But this very difference of proportion will suffice to define the group, if we can establish that it was not accidental, and that the group, as it evolves, tends more and more to emphasise these particular characters. In a word, the group must not be defined by the possession of certain characters, but by its tendency to emphasise them*ƒ*. See Henri Bergson, *Creative Evolution* (Dover Publications Inc., 1911).
24. Donato Totaro. Gilles Deleuze s Bergsonian Film Project*ƒ*. *Offscreen*, 31 March 1999.
25. Manuel De Landa. *Intensive Science and Virtual Philosophy* (Continuum, 2002, New York/London).
26. Ibid., p. 58.
27. L. Moholy-Nagy. *Vision in Motion* (Paul Theobald and Co., 1965, Chicago) p. 280.
28. Martin Dodge and Rob Kitchin. *Mapping Cyberspace* (Routledge, 2001, New York).
29. See Francisco J. Varela and Evan Thompson, Neural Synchrony and the Unity of Mind: The Neurophenomenonological Perspective*ƒ*, in (ed.) Axel Cleeremans, *The Unity of Consciousness: Binding, Integration and Dissociation* (Oxford University Press, 2003), p. 279.
30. For a detailed analysis of these terms, see Warren Neidich, title essay in *Blow-up: Photography, Cinema and the Brain* (DAP, 2003), pp. 22-30.
31. Paul Virilio. *The Vision Machine* (Indiana University Press, 1994, Bloomfield), p. 14.
32. Blow-Up*ƒ* is the story of the mutated observer*ƒ*: one whose neural networks have been sculpted by artificial stimuli to the point that he has become what I call cyborg-ised*ƒ*. Thomas, who plays the role of the fashion photographer David Bailey, has two types of memory. One is the result of his own experiences; the other the result of the memories of the photographs he has taken. As the photographs are more phatic*ƒ*, they compete for the brain s neural space more effectively. He loses touch with his own feeling and memory when these are not supplemented by photographic documentation.
33. Celia Lury. Just Do What? The Brand as New Media Object*ƒ*, inaugural address given at Goldsmiths College, London, 2004.
34. Ibid.
35. Ibid.