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Language and other Media

Cosmological Memory Space and the Origin of Human Language

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Abstract: Spatial cognition as the proper cognitive background of human memory had already been propounded in antique mnemonics (ars memorandi). This train of thought was expanded to cosmology by Giordano Bruno (1548–1600) and, in turn, further developed to infinite space and (Copernican) cosmology. However, a range of local frames for cognitive operations has to be considered which rehearses an evolutionary hierarchy of framings. The evolution of language can be considered as the central instance in the evolution of consciousness. First, three levels of spatial cognition (body centred, interactive/social and long ranging/cosmic) are defined and their contribution to the evolution of human language and higher levels of consciousness are described. The second level of spatial cognition, where tools are manufactured, goods exchanged and art appreciated links the embodiment of meaning to mythical/cosmic thinking (first and third level). Recurrent patterns of locomotion, path finding and action involving objects and other humans stand at the heart of these cognitive capacities. They result in archetypal schemata underlying the syntax/semantics of human languages. The largest frame of human intellectual orientation concerns the motion of the sun, the moon and the ensemble of the stars at night. This was the starting point for astronomical knowledge and thus for the reflection on cosmology. Finally, the paradox of creativity versus cultural conservatism is discussed as an outlook.

Cosmology and consciousness

Beyond the view of an isomorphism between the macro-world (the universe) and the micro-world (man and the human mind), which dominated in medieval and early modern time, there is still a strong intuition that both spheres are linked by common laws. One must however distinguish between the fact that both are the product of human cognizing, reflection and discourse, dependent in their evolution on the cultural contexts in which they arise and gain acceptance, and a possible causal connection between cosmological and cognitive laws. If the first seems to be obvious, the second is highly questionable. I will approach the problem from a historical perspective (history of ideas) and from a theoretical, mainly cognitive and mathematical perspective. First, let us consider the historical perspective.

Two major advances in considering theories of the universe and the mind were made in the Greek enlightenment period (between 600 and 300 BC) culminating in the work of Plato and Aristotle and in the European Renaissance (which after a long pause took over this thread; between the mid 15th and the end of the 16th century).

I will pick out one intellectual figure from the 16th century, Giordano Bruno (1548–1600).[1] In his extensive mnemonic writing he combined the cosmological tradition (first Lullus, then Copernicus) with a theory of the mind, i.e. of human memory, imagination and inventiveness (ars memorandi et inveniendi).[2] Despite of his fatal conflict with the Catholic Church (he was burnt at the stake in Rome 1600), his scientific work opened a complex field of thought between the philosophy of nature (cosmology) and the philosophy of mind (memory, language, creativity). In the Platonic tradition (of Greek Pythagorean thinking), he applied basic mathematical tools to both fields: the combinatory art and discrete dynamics of Lullus and the geometry of concentric circles and hyper circles in Copernican astronomy. Thus, all proper ingredients for a modern treatment of the question of how cosmological laws are related to human consciousness are already present in a pre-modern form as a relational triangle: cosmological model, model of the mind and algebraic/geometric concepts.

In the following chapters, I will concern myself specifically with language, which is the major manifestation of human consciousness and with the evolution of this endowment, which is a defining characteristic of the human species. Other aspects of human consciousness may be derived from linguistic capacities or may be analyzed along the same lines.

Ars memorandi and cosmology in Giordano Bruno's philosophy

The classical view of mnemonics[3] uses spatial constellations and architectures (in the house, the market place, the town) as conceptual frameworks. The recalling of memories is imagined as a journey through a mnemonic space (a 'theatre' of memories). This view of human memory assumes a common geometry of man-built and natural space and the 'space' of human knowledge and consciousness. In the Neo-Platonist view which dominated Italian philosophy in the sixteenth century, human

1 Major aspects of his philosophy are treated in nine essays and nine fictive dialogues with his contemporaries in Wildgen (2011).

2 Cf. Wildgen (1998).

3 'ars memorandi', i.e. art of practicing one's memory or 'artificial memory' for professional orators.

concepts are grounded in eternal ideas ('ideae') having their domain outside or at the frontier of the universe, possibly in astrological figures or in celestial spheres outside the sphere of stars (spheres of angels or the 'Empiraeum'). Thus, they are not affected by the ever changing nature of all things in the sub-lunar world (cf. Aristotle's 'generatio et corruptio'). The realm of these ideas may be called cosmic. In order to interact with the material world two parallel but interactive types of cosmos may be conceived: The discrete world of perceivable material entities and the continuous (fluid, ethereal) world of ideas. The human mind is just a tiny sub-field of this basic duality.

In his first cosmological treatise, the dialogue *The Ash-Wednesday Supper* published in London 1583, Bruno defends a Copernican cosmology and extends the heliocentric cosmology to an infinite universe, with an infinite number of solar systems (each of which is finite and may contain similar objects, animals and even intelligent beings)[4]. The idea of an infinite universe had consequences for Bruno's theory of memory and language. The grid of the human memory space which was discrete using a combination of cells (quadratic or at least equilateral and symmetric subspaces) became unlimited and conceptual journeys, able to produce discourse were infinite. The conceptual (mnemonic) grid could be modified by metaphor or metonymy so that the reading and interpretation of the memory contents allowed for creativity, invention, even fiction. This distinguishes Bruno's mnemonics from the classical tradition which was rather reproductive than inventive, and it announced Leibniz' 'machine of conceptual innovation,' i.e. the impulse for machine intelligence.

In the light of actual cognitive sciences and neuro-psychology, the mnemonic tradition has been revitalized. Mental spaces conserve the topology of external space in the visual field, i.e. retinal projections onto the visual brain are topology-preserving. Insofar as the visual brain is one of the oldest architectures in the brain and as visual memory is very powerful, the technique of enhancing human memory of words and linguistically coded facts by using visual analysis and memory is a promising strategy. In general, multi-modal memory retrieval is more effective and stable than the uni-modal one (thus common nouns are more easily remembered than proper names). The brain has an architecture which does not mimic the geometry of our universe. There exists, however, an intermediate level, i.e. navigation in the real world and navigation in the world of memories which shows common features. This intermediate level is based

[4] This idea was rejected by the astronomers of his time (including Galileo and Kepler). Herschel (after 1784) was the first astronomer to consider the organisation of the outer sky as an accumulation of solar systems extending into the depth of the universe (cf. Wildgen 2011: third essay).

on a proper orientation in the ambient world, monitored by goal oriented strategies, and is thus near to consciousness. At this level, a parallelism between visual and motor behaviour and memory retrieval in discourse is plausible (cf. Belleza, 1987 and Wildgen, 1998: 234–238). This is the empirical foundation of antique, Renaissance and modern mnemotechnics.

Bruno's move from a finite and rather restricted view of human consciousness towards an infinite and highly inventive consciousness was a radical one. Instead of the consolidation, defence and teaching of a given corpus of knowledge, as practiced in medieval universities, it focused on imagination, invention, and innovation. Its aim was not just the encyclopedic organisation of knowledge (in an optimized memory) but also the creation of new knowledge. The fact that this view provoked the fierce opposition of all religious parties (Catholic, Protestant and Calvinist) shows that Bruno initiated an intellectual revolution which went beyond the astronomical provocations by Galileo and Kepler.[5]

The post-medieval view (still dominant in many Christian and Islamic communities) was that the space of allowed thinking, imagination and innovation is strictly confined and has above all to respect some standard interpretation of the Holy Scriptures (under the authority of some acknowledged institution). For Galileo and Kepler, the new heliocentric model was mainly a technical (mathematical) innovation and they thought it would not provoke any conflict with religious creed (in fact, one had just to accept minor modifications related to rather marginal passages in the Scriptures). The fact that Rome has not yet revised the legal process against Bruno (but has that of Galileo) shows that his revolution of modern intellectual consciousness is still seen as provocative and dangerous.[6]

To summarise this short historical overview, we conclude that Renaissance philosophy opened the field of philosophical and cosmological consciousness beyond medieval restrictions and that Bruno's model of an infinite space of human conceptualization and argument opened the door to European Enlightenment and to modern science in the 17th and 18th century. The 18th century progressed much further by introducing the anthropological dimension of language and thinking. It formed the beginning of all modern explanations of the origin of language (even before

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5 Galileo was finally condemned in 1633, Kepler was chased from Prague and later from Graz and never received the promised funds from the emperor for his Rudolphine Tables (published in 1627).

6 Most modern cosmologists and physicists presumably don't accept any religious or political restriction of their scientific work. Nevertheless one should not be too optimistic, because mainstream thinking and fund raising conditions may have taken over the role the Christian churches played in the 16th century (and would like to play today if they could).

Darwin's explanation of evolution in 1859; cf. the contributions by Condillac, Maupertuis, Rousseau, Diderot and later Herder after 1746).

But the openness and infiniteness of the space of consciousness does not mean that in a specific moment, for specific operations the human mind has no frontiers, and that the transition of barriers is easy or that the operations of the human intellect are arbitrary. As in Bruno's cosmology, every single world in the universe is finite and most events are happening in this finite frame. These finite, local frames are infinitely embedded in larger frames and no absolute frame can be conceived by humans.[7] How to form our conceptions of the universe and of the human mind is therefore not a theological or philosophical question but rather one of intellectual strategy, which can always transgress given frames. In a larger sense this was also true for mankind on its path from biological to cultural evolution, which is a story of frame changes and extensions. Therefore, different (genetically or culturally given) frames were constitutive at different stages of the evolution of human consciousness. In the following section I shall adopt an evolutionary perspective in order to understand both this framing and the dynamics by which frames change and are driven further and further towards an (unknown) limit. I will take human language as the central domain where human consciousness appears and is specified (nevertheless, many automatic processes in language understanding and production are unconscious, but form the basis of human consciousness).

[7] Penrose (2005: 760) discusses the importance of an infinite universe for the existence of sentient life: "For if sentient life is possible at all, then we expect that in a spatially infinite universe, it will occur, even if conditions for sentience are extraordinarily unlikely to come about in any finite region of the universe." Bruno's assumption that all other solar systems were more or less identical to the system in which we live was too optimistic. Our solar system at the rim of our galaxy is in fact rather special and the constellation of moon and earth as a tandem may also be exceptional. Nevertheless if the universe is infinite there should be other solar systems similar to ours and it is highly probable that they have developed or will develop intelligent beings. The mere fact that we exist and that our existence can be explained via the laws in this universe creates the security that this has or will happen again and again.

Instead of consciousness in absolute terms, I refer rather to several levels of consciousness, where specific cognitive faculties emerge:

1. The baseline for human consciousness is defined by the operations of perception, motor control and memory. Together they form a cognitive complex allowing for specific behaviours in a species like humans. These behaviours may be selected (i.e. be successful or not in survival and procreation) and further expanded.
2. The mental operations underlying these behaviours call for brain architectures. These are again enabled via genetic information, energetic conditions and contexts of maturation. Thus, basic results of (Darwinian) selection may be further developed due to such internal trends. As brain growth was such a trend, it may have allowed the expansion of perceptual, motor and mnemonic capacities and thus reached a level of complexity where consciousness emerged as a feature of human behaviour. This may be called the morphogenesis or the self-organisation of consciousness.
3. The self-organisation of consciousness (cf. 2) triggered a new type of social behaviour and social organisation which became selective at the level of conflicts or rivalry between human sub-species and regional varieties. Alternatively different varieties may have been integrated during periods of crises (cf. ice-ages) producing more powerful social groups and founding a kind of social organisation dependent on individual and collective consciousness. At this stage 'cultures' emerged and began to 'self-organize' the product of human evolution in new contexts.[8] This finally resulted in giving consciousness a central role in the further expansion of human cultures and their techniques (art, science, religion, law, politics etc.).

These levels are still operative and can be observed as aspects of human behaviour. In the novel *À la recherche du temps perdu* (*Remembrance of Things Past)*, Marcel Proust describes how the smell of a cake evokes a whole cascade of biographic memories. One may presume that, as the gustatory and olfactory senses are linked to rather archaic neural structures, this or a similar type of memories dominated in the mental life of

[8] The concept of 'autorégulation' was introduced by Jean Piaget (cf. Piaget 1972: 71–75). If a species reaches a new level of organisation, the potential of this evolution can be unfolded via self-organisation. 'Cultures' are thus self-organizing structures exploiting the potential given by biological evolution. Chimpanzee 'cultures' can achieve this to a certain extent, but humans exploit it maximally (cf. Wildgen 2010 for the role of self-organisation in the evolution of language).

early hominids, e.g. the Australopithecus some 3 to 4 million years BP. Memory is linked to specific space-time scenarios (*external* cues) and to specific gustatory/olfactory features (*internal* cues). Further evolution will change the structure and balance of external and internal cues and generalize over different kinds of senses. If the external memory space of animals (mammals and later primates) is rather a piecemeal of situations and aspects of them (like the early memories evoked by the cake in Marcel Proust), then the human mind puts these pieces together in a double fashion:

1. The different senses (classically five senses are distinguished, but modern psychology has driven the number to 30) are integrated into a kind of 'common sense.' This hypothetic entity (neural correlates could exist in the frontal lobe) is nearer to consciousness than to the physiological senses, is a presupposition of culture, and is further specified in cultural evolution.
2. The 'piecemeal' topology of local situations is integrated into larger and more coherent fields and fitted to a complete view of the ambient world/ecology. Finally, in the sciences, a total view of the universe integrates the local views of regional domains and relates their regularities to universal laws of nature.

The complete and unrestricted knowledge of the world remains a goal never reached. If we examine human language more closely we can see different advances towards this goal which may reflect evolutionary periods (in this sense human language is a quasi-fossil of the evolution of consciousness).

If we take the spatial behaviour underlying the cognitive capacities of the nearest existent hominids (chimpanzees) as an analogue of capacities of the last common ancestor (LCA) some 5 to 7 m.y. BP, it is clear that they are able to cognize a certain territory with its frontiers (where other chimpanzees of a different group live), positively or negatively loaded locations (food or water supply versus danger/death, possible attacks), and places of shelter. We can describe this space as basically middle range (beyond the motion of the proper body, but stably restricted over long periods) and three-dimensional (the third dimension was important for quick locomotion in the trees). At the stage of the Australopithecus who roamed in the savannah but still used trees for shelter, the space became flatter (the savannah); lakes, rivers and shelters in cave entrances gained importance (cf. the landscape in the East African rift valley).[9] Another domain of spatial cognition was unfolded by seasonal migration, follow-

[9] Cf. Wildgen (2011b), in which the evolution of architecture is discussed.

ing the herbivores (cf. the migration of current hunters like lions in East Africa). Later, i.e. after 1.6 m.y. BP, the migration routes left the African continent and Homo erectus populated Asia. During migration he/she had to adapt to very different climates and to the waves of climatic changes which occurred mainly in the Northern hemisphere. This means that the new species had to cognize a variable space due to migration and to rather quick climatic changes. The rain forest was quasi a closed three-dimensional space with the roof of canopy trees as a vertical limit. In the savannah the moving sun during day time and the moving moon/the moving stars replaced the green 'roof' of the rain forest.

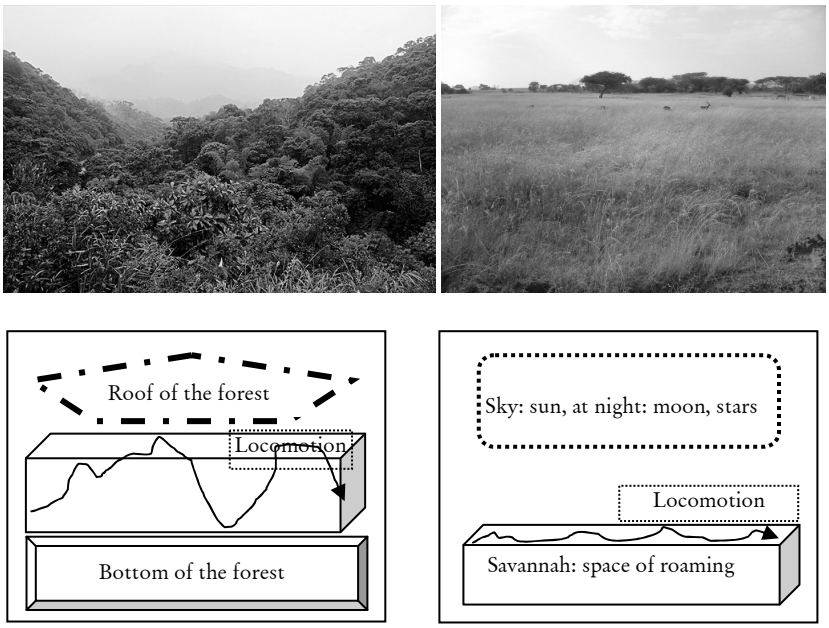

Figure 1: Rain forest (left) versus savannah (right): examples and schematic analysis

For spatial cognition this meant that it was not sufficient to know the network of interesting places. The individual or the groups of scavengers / predators had to use a *mental map* of the area. This mental map was essential in the pursuit and retrieval of prey. Also, in order to recruit hunting partners a primitive protolanguage had to be used in order to provide a coherent description of the location. (cf. how bees and ants recruit helpers). We shall call this extended open space, the *long distance space*. The sky and on it the moving sun, the moon, stars became part of the human ambient space. This is the natural origin of man's interest in cosmology.

As the spatial range between the individual body and the global space grew, an intermediate space domain gained importance, becoming the cradle of symbolic thinking and communication. At this stage collective activities like tool manufacturing, exchange of goods (or social redistribution), child rearing and fire, i.e. the more intricate social life which would distinguish Homo sapiens from other hominids, appeared.[10] The question is: Where does language emerge in this configuration and what function does it serve? We may consider three main source domains for linguistic skills in cognition and behaviour.

1. Cognition at the *intimate space*. This covers: perception, control of hands, memory of the proper body, and kinship caring. This seems to be the root of all part-whole taxonomies and concerns recurrent process schemata of motor control of limbs, ingesting/ egesting, touching, automatic grasping/releasing etc. (cf. Wildgen 1981 and 2004: chapter 3).
2. The intermediate space of *manufacturing tools* and of common activities like butchering, cooking, child rearing and caring for members of the group. The evolution of more altruistic forms of social interaction is on a par with these tasks and group activities such as dancing, music and ritual ceremonies expand this development. The process schemata which emerge are related to recurrent or ritualized practices which link different agents with types of objects. The invariants of theses processes become the core of argument structures and syntactic constructions in fully-fledged languages. Causality (e.g. motivation, goal orientation) emerges from these schemata.
3. The space of locomotion at long distances, *migration* and later *navigation* with boats along islands or directed by the orientation of stars on the night sky (cf. the techniques and maps of Melanesian travellers). External landmarks are here used for orientation: mountain peaks, rivers and shorelines. Some of these landmarks are in motion, e.g. the sun, the moon, the stars at night and they also change with the seasons. In this context one has to consider that since the australopithecines, and once upright locomotion became dominant, early humans lost their fur covering and expanded daylight journeys in the sun in pursuit of prey or in search of cadavers. This was a constant during the next millions of years and could select for cognitive strategies and genetically predisposed cognitive schematizations, enabling the perception and memorization of gestalt complexes, which correspond to basic sentences (with 1 to 3 arguments of a verbal core; cf. Wildgen 2004: 166–171).

[10] New research published in 2012 shows that already around 1 my BP fire was used by Homo in Wonderwerk Cave, Northern Cape; cf. Berna e.a. (2012).

The precise context of the emergence of human language capacity remains unknown. Several scenarios (cf. Wildgen 2004 and 2010) are plausible.

First, at the level of *intimate interaction*, with longer child rearing (due to the maturation of the brain after birth) the mother-child communication became prominent. As larger brains are observed since Homo erectus, this could have been the period for this evolutionary step (ca. 2 m.y. to 500.000 y. BP). As we note in current mother child behaviour, a rather long period (7 to 8 months) is reserved to phonic although non referential communication. Rhythms of speech, emotional values, quasi the music of language is what counts in the establishment of a strong communicational link between mother (care giver) and child. As a spandrel effect, this enlarged emotional code (its music) could have changed the courtship patterns and thus the behaviours of males in relation to females (and to children they care for). Such a pattern could easily become a preference in sexual selection and drive a run away evolution maximizing phonic repertoires in women and men. This phonic (emotional) evolution of communication probably did not enlarge considerably the referential lexicon beyond that of primates (three to five stable referential categories in alarm calls).

Second, the medium scale space where group internal social cooperation and communication was central and where technical skills had to be enacted and taught. This was probably the source of a more sophisticated referential communication. Eventually, a lexicon which grew beyond 50 items triggered a process of self-organisation in which simple morphological paradigms, such as in nominal composition or the distinction between nominal and verbal items, and thus the basics of sentence patterns, could emerge. This was possibly the 'real' start of human languages beyond the repertoire of social and alarm calls in primates, and thus the start of human consciousness based on language. In parallel or in co-evolution, other symbolic capacities, like tool technology, figurative art, music, emerged and produced the 'homo symbolicus' as Cassirer calls this stage in his philosophy of symbolic forms (cf. Sandkühler, Pätzold et al., 2003 and Wildgen 2004: chapter 9). This intermediate level (neither the individual body, nor the global reality are in focus) is able to conserve the knowledge of earlier generations, to establish the continuity/identity of civilizations, the oral (later written) traditions of history and myth, a religious creed unifying large populations beyond political units, and a universe of shared values for ethics, politics and art. The question arises: how could humans communicate and thus conserve this symbolic space? The symbolic faculty required grounding in the senses *and* in the external world. Therefore, the *double* nature of the sign was the proper solution and became the basis of a fully unfolded human consciousness.

The tremendous potential of signs becomes visible when applied to natural forces and cosmological processes. The rising and setting sun, the pale moon light and its transformation of the visible world, the strange but lawful motion of uncountable stars, the hazards of life, human fate and many macro-events beyond individual life space become accessible with the use of symbolism. This transcendence of sign use in search of a global and unlimited understanding is the third stage, where *religious* and *cosmological consciousness* emerges.[11]

At these levels of spatial cognition and language, different types of event- and action-schemata emerge.[12] The schematization of event structures is perhaps the most fundamental achievement of early human intellectual evolution and it was only firmly established by Homo sapiens, i.e. some 300.000 y. BP.[13] The social and symbolic skills of Homo sapiens were the reason for his survival and rapid expansion through Asia, Europe and into the Americas.

In the following, I will consider two central types of action based on symbolic (and linguistic) skills: tool manufacturing (in industries with stable standards) and exchange (commerce with stable exchange rates and values).

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[11] The evolutionary link between religious and cosmological thinking was evident in religions based on the sun, the moon, the ecliptic, etc. It was superseded by religions having a kind of warlord as central figure (e.g. in the Mosaic tradition). Nevertheless when a profane astronomy came to public perception (with Bruno, Galileo and Kepler) the organized religious communities felt endangered and tried to repress such a demystification of the heavens.

[12] If these schemata are abstracted, the event and action structure can be related to constants in dynamic systems theory.The mathematical study of kinematics and dynamics started with Zenon's paradox of Achilles and the turtle/tortoise. It was further developed by Archimedes in Greek antiquity and continued by Galileo, Kepler, Leibniz and Newton in modernity. The consolidation of 'analysis situs' in the 18th century (e.g. Euler) led to the advanced dynamics of Poincaré, Einstein and was the central topic of modern mathematics in the work of Thom, Penrose a.o.

[13] Recent research suggests that between 195.000 and 123.000 y. BP the species Homo sapiens was going through a bottle neck near extinction and had for climatic reasons to survive in rather small pockets in southern Africa in caves near to the shore (cf. Marean 2010). The Homo neanderthalensis who had migrated to Europe and Asia earlier (he is considered a descendant of the Homo heidelbergensis or similar types living in Europe around 400.000 y. BP) did not share this evolutionary period with Homo sapiens. Although his tool technology was roughly the same as that of Homo sapiens, the growth of his body and brain (i.e. his early childhood) were different as the analysis of child bones shows. We may conclude that the typology of actions and the complexity of social action (and social competence, altruism in cooperation) were radically different.

1. Tool industries presupposed the systematic striking of a stone by a tool (another stone tool or a bone). The shock wave could split certain materials (e.g. glass-like stones from volcanic origin) and produce a sharp edge, which facilitated the cutting of fur and wood. Only a small percentage of the worked stones were used as tools as the archeological analysis of Paleolithic working places shows. The best pieces could be fitted to wood shafts using specifically manufactured glues (mainly birch pitch). The constitutive actions are striking and splitting. The underlying schema is that of capture and emission (two basic dynamic archetypes, cf. Wildgen 1982: 43f.).

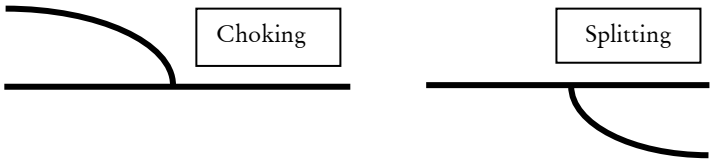

Figure 2: Schema of CAPTURE (choking) and EMISSION (splitting)

2. In exchange and commerce, the basic schema is that of GIVING (or mutual giving). It implies two agents and a third entity, which is exchanged (it changes its proprietor). Additionally a fourth imaginary entity emerges, the exchange value. It will later in the cultural evolution be substantiated by valuable materials (feathers, shells or silver, gold or money or banking transfers). The inherent dynamics of this value system are more complex than simple exchange. In modern chemistry such mediating forces are called catalysts; they enable a process but are not changed or spent by it.

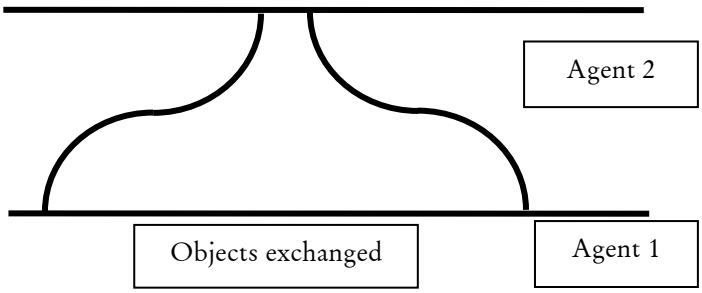

Figure 3: Schema of GIVING (mutual)

The extra field which mediates the equivalence of the two exchanged objects has the features of a code, i.e. it prefigures or accompanies the emergence of symbolic systems, such as language. In the case of mutual ex-

change the agent/patient roles interchange, but the binding force (the value) is invariant.

Our central hypothesis is that the emergence of a mediating symbolic system (of exchange values, of ritual rules, aesthetic values and grammatical rules) was the starting point of the new 'symbolic' species. It opened the way for unlimited, cosmological consciousness.

Consciousness and human creativity

Beyond the important symbolic faculty and the resultant social networks, there is another astonishing feature which has to be addressed: *human creativity*. In many cases this faculty which enables cultural innovation and progress seems to be in conflict with the social and political organisation of humans insofar as it tends to break or destabilize traditions and established order. Even in modern societies the creative individual (artist, political activist, and scientist) is often considered an enemy, or a danger to public order. This creates a paradox: on the one hand cultural and political progress depend on the effect of innovation (often driven by creative minorities), on the other hand these societies (although they profit from such innovations) tend to repress the individuals responsible for such changes.

Inventiveness in the search for resources (food supply, chase and scavenging strategies etc.) may have been selected originally. However the increase of brain capacities enabled by high energy food produced human intellectual and artistic creativity as a secondary effect. This effect became vital as soon as the society entered a phase of crisis. This produced the ambivalent nature of human creativity. In the phase of crisis or danger (due to conflict with other societies or to natural catastrophes) the latent potential of creativity was required. In this phase a selection on criteria of inventiveness could occur. It was immediately stopped as soon as the conservation of the status quo gained priority. Thus human creativity drives cultural evolution but it is also driven (furthered or repressed) by this evolution.

In summary, human consciousness is an open field which can be explored individually and can be repressed or promoted in different social/cultural contexts. If it is repressed, this may guarantee a good level of stability at least for the reigning class. Insofar as innovative communities are more competitive (in industry, science, commerce, art, politics) the chances for success (or even survival) in conservative communities decrease rapidly.

If we look back to Bruno's cosmology of an infinite world, we can say that the space of human consciousness in a specific phase of human

evolution looks as if it was finite and even clearly limited. These limitations are, however, fluid on a larger scale. During their life time, individuals may enforce a rapid intellectual development which breaks these barriers and societies which try to banish individual creativity will eventually lose out against societies which exploit the individual potential for creativity. The proper equilibrium between individual creativity and the advance of collective consciousness remains a problem to be solved in any period and in any context.

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