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The Metaphysics of Information
The Power and the Glory of Machinehood

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The rise and rise of the cluster if not indeed galaxy of concepts around information, computation and computability, such as analog/digital, (software) program/hardware, information-processing, module/modularity, (Monte Carlo) simulation, binary coding, bits (binary digits), algorithm, networks, virtual, clone, code, interface, machine language, computer memory, cybernetic notions like feedback, feedback loops, feedback control, and the like (with a number of roots like *cyber, tele-, net- , e- , i-, a-,* as prefixes for an ever-increasing number of new words, in technical and general use, either with physical referents or purely figurative) is a central feature of the world story of the last sixty years or so. These concepts and their "families" have come to occupy increasingly dominant and resonant positions in the sciences and technologies, through vigorous long-running research programmmes, refashioning, integrating or synergizing a great variety of technologies, as much in the realm of our imaginative life as of our material practices, not forgetting the key domains of law and medicine, throughout today's world, is undoubtedly one of the most remarkable surges of great concept-clusters in recent history. I am not sure whether we have fully entered the age of "universal cyberspeak"[1], but, together with

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"market-speak" (the precepts, concepts, specific tropes and set phrases of market economics, accounting and management) it has spread, and will doubtles go on spreading for some time yet, throughout our social world and our *globus intellectualis*.

Given its ubiquity today, the recency of the Information Galaxy is astonishing, since Shannon's information concept/theory dates only from the 1940s, and one is surprised that no-one appears to have suggested a periodization of world history in terms of B.S. and A. S. (Before Shannon; After Shannon) or B. IT and A.IT, before and after the advent of the informationalization process now sweeping economy, society, war machines, the "mode of (scientific) knowledge production", and as knowledge is increasingly not only capital (the concept of "capitalization of knowledge" was formulated, at least in these terms, not by a Marxist, but by liberal economists) but an increasingly important strand of total capital, the overall mode of production as it obtains today could be labelled the "informational mode of production", so to speak, or "digital capitalism", as many writers have already argued. To be sure, key conceptual and operational elements or forerunners of these developments are much older, of course[2], though in overall terms one may call it a *novum* with a reasonable degree of prima facie justification. In any case this concept, or its reflections and cognates, an array of concepts bearing some degree of apparent or contrived family-likeness, together with the indispensable array of associated concepts/tropes/icons as noted, in what one may call the informational constellation, has come to pervade, nominally or substantially, contemporary thought or contemporary discourse in every domain. Under its aegis, extraordinary transformations have been taking place and/or are still in process in every phase of contemporary economic enterprise from the micro-level to the globalization processes, financial and productive, so salient in our age, though not unprecedented in kind, or even, until recently in proportionate scale ("Information rules!"), entertainment ("infotainment" in more senses than the one originally envisaged, or "image-engineering"), education ("edutainment" or "infotainment" too), science ("infoscience") and technology ("infotech"). Thanks in part to the very commonalities, convergences, synergies and reticularities of IT or ICT (information and communication technologies) and information discourse in its widest range, these domains overlap and interpenetrate in ever more extensive techno-conceptual ways, so that, in many ways, it is becoming increasingly difficult to distinguish sharply and unambiguously between almost any pair of proceedings within this list: *science, engineering, commerce, finance, production, marketing and entertainment*, even if we should want to anymore.

It commands contemporary debates concerning technology, and indeed the control, design, production and potentiation of all other varieties of technology (and of itself), which renders the technology of information and computation a kind of meta-technology, the first-ever. Under its banner, great research programmes have been in process for several decades, constantly renewed despite notable impasses, periods of stagnation and the recurrent defeat of public forecasts, such as the robotic, the Artificial Intelligence, nanotech/atomtech or quantum computation ones, as well as more strictly "scientific" research programmes (to resort to an increasingly obsolete terminology) in Artificial Life and other lesser ones. Information technologies (ITs) or information and communication technologies (ICTs), have increasingly shaped the post-industrial or ultra-industrial economy, or the New Economy where "information rules" (though it is easy to exaggerate the direct role of the more advanced technology in wealth-generation, as the much-cited,

baffling paradox of the near-invisibility of the computer revolution's impact in national income accounts in the US, until very recently, shows[3]).

More specifically, one should list the bioinformatic industrialization of genes, genomes, organisms, the opening of new horizons in the technogenic shaping or industrialization of intelligence (creating for the first time non-biological intelligence, that in itself a *novum* in which many have seen something of transcendent import, now available in an endless stream of varieties and potencies), of mind (neuroscience is surely pregnant with neuroengineering, in association with IT creations such as magnetic resonance imaging), of consciousness (as yet incipient, except insofar as the mass media exercise McLuhanite effects, or resonances, but consciousness engineering would seem to be implicated in neurocom-putational science), persons (some info-projects have been named as "building the Artificial Person", a kind of techno-Leviathan[4]), the environment (a "Third Nature" supervening on the second nature which earlier technogenic transformations have brought about, or what Moscovici called the "cybernetic state of nature" some decades ago[5]), jurisprudence, medicine, the current prospects for natural life and evolution, and, increasingly, in more direct fashion, for humanity itself. Theologians are aware that they have not yet entirely taken on board the implications of the Information Age, even in the case of the "theology of creation", the school of Catholic social doctrine most sympathetic to capitalism in its present technocapitalist, or infotechnocapitalist, incarnation ("creation" in the name of the school subsuming, and indeed privileging, "wealth-creation" by entrepreneurs), but in any case, whatever the failings of theologians, the informational constellation has been bought to bear on key issues of natural theology to the extent that in effect there has been a kind of renaissance of "physico-theology", especially through information/digital physics and speculation on the extreme possibilities of computer technology (simulation via infinite information-processing) and the rebirth of "physical eschatology" (Freeman Dyson).

The impact on all the contemporary arts, at any rate in the West and in Japan, but to some degree everywhere, direct or indirect, is plain: much of what goes on in the arts, whether the plastic arts, performance arts or music, pop or non-pop, folk or non-folk, can be seen as "experimenting" ever more indulgently with the new technical possibilities of audiovisual media and subjects, exploring the ideational implications of the technologies, and commenting endlessly on them, and the forms of life around them or the worldhood they define, bearing in mind that in much contemporary art the work and the aesthetic metacommentary have become practically one, and the boundaries of what were once called the fine arts and what one might call *technoludics*[6] dissipated (too early perhaps to assess genetic art, artificial life art, and the like).

Curiously, the philosophical issues raised by work in virtual reality (in part a realm of technoludics), more than the issues raised by say computational theories of mind or organic life, or by information-centred approaches in any field of the sciences, that have been perhaps the ones that most strikingly engaged discussion and controversy of an openly metaphysical kind. The saliency of these issues may illustrate Whitehead's famous dictum, that philosophy is (still) a series of footnotes to Plato, or it may stem from the shameful insight that we were still "Platonists" at heart. In any case in the metaphysics (or theology) of virtual reality the central question is perhaps whether a "virtual realism", a somewhat paradoxical realism concerning virtual reality, is defensible. In the (real) world at large, Virtual Reality may have become a kind of transmission belt for an inverted "Platonism for the

masses", to borrow the accusation which Nietzsche famously levelled at Christianity (though Thomism surely was Aristotelianism for the Christian elites, though admittedly with a goodly admixture of Platonism), if not the "opium of the people"[7], in addition, it is true, to the worldwide cornucopia of opiates prodigiously available today, in legal and illegal markets, chemical or electronic, for both masses and elites.

But one may also argue that it may be seen as the "opium of the intellectuals"[8] one way or another, and even, one might venture to say, the opium of the scientists in their obsessively simulational scientific practice and monomaniacal informational philosophising. Some live off, others live for, still others live in, or want to live in, partial or even total immersion in Virtual Reality: considering the amount of philosophical or sociological writing on VR, it is plain that an increasing number of people do live off, or live connected to VR one way or another…. Should we, as Virilio claims, acknowledge that there has come into being thereby a third ontological level beyond essence and appearance, the *tertium* being here the "trans-appearance" precipitated by VR?. This is certainly an intriguing suggestion, one of several very striking, far-reaching claims which have been advanced in the new domain of the metaphysics of virtual reality. The most discussed variant of the contemporary version of physico-theology, naturally computational, so Artificial Physico-Theology rather than a branch of natural theology in the old fashioned sense, is debating whether perhaps eternal life, the resurrection, immortality, belong in the realm of virtual reality, or there too (if there are sciences of the artificial in the strict sense of "science" there are also appearing, as in this example, *wisssenschaften* of the artificial, "sciences" of the artificial in the broad sense of "science", or, if you like, "*humanities of the artificial*", of the digital, of the virtual).

There is no discipline in any branch of science, mathematics, natural science, social science, human science, descriptive, experimental or theoretical, qualitative or quantitative, that has not been affected at various levels of instrumentality, conceptualization, model-building, in the choice of heuristic or ontological metaphors[9], and the direction of research, in some cases quite profoundly and decisively by the informational computational constellation. In some areas, the impact is still limited: cybernetic political science has not come to dominate the field, or even assume major importance as yet, despite the early start with Karl Deutsch's treatise[10], for instance, and the same is true of the Artificial Societies research programme ("AS", after all, is not yet a generally recognized acronym) or even of Artificial Economies. But all in all we may be witnessing a process that could eventually transform to some degree the whole of scientific knowledge or knowledge-production, a pan-scientific revolution, as well as every facet of engineering[11]. Indeed, on current trends, every science that really counts, with honourable exceptions, will not only be the basis of, but interchangeable with a branch of engineering, as already happened with some branches of the life-sciences, and may be imminent in neuroscience[12]. With the advances in artificial, computational, digital sciences and of the concomitant engineering in simulation and in material practices, not only every branch of science, but every branch of learning, all "*wissenschaften*", instead of aspiring to the condition of mathematics or of physics (the famous syndrome of "physics envy", and the uneasy feeling that science is either physics or "stamp-collecting", in the famous phrase of the physicist Rutherford), as appears to have been the case until recently, will now aspire to the status of a branch of engineering[13]. In any case, inspired by current technocapitalism[14], already economic, social, cultural and political history in every western country

going back at least to the eighteenth century, is being rewritten from the perspective of the role of engineers and engineering, in a literal sense of these terms, though sometimes in a more relaxed sense, and no doubt this trend will continue for some time to come.[15]

Many commentators have already designated computer simulation research as a "third kind of science", in addition to if not virtually supplanting in some cases, the old-style theoretical and physical-experimental types of scientific work (not to mention natural-historical knowledge in the sciences of life and the earth). H. Simon (a Nobel Laureate in economics, though more a remarkable inter-disciplinary scholar than an economist), a leader in the computational research programme of AI, through good and bad times, advanced the concept of the "sciences of the artificial", but one may well ask whether we any longer have natural sciences, "sciences of the natural", partly because "natural nature" in contradistinction to technogenic or anthropogenic nature, "artificial nature" (Sorel) is receding, partly because observational or natural-historical knowledge has been depreciated or lost (like artisan or craft knowledge and all sorts of culinary skills, the depreciation of experiential knowledge being the subject of adverse comment even by professors of engineering), partly because simulation research has artificialized large sectors of the natural sciences in a new way (consider only the recently developed Artificial Ethology, the development of robots to mimic a great variety of animal functions and capacities, with a view to profiting technologically from the modes of operation elicited, or Synthetic Ethology, the simulation study of virtual animals, both which bear the name of one of the most observation-intensive, "field" disciplines of the life-sciences). At any rate, in addition to the sciences of natural beings, we now have sciences of artificial (digital) beings, whether they be artificial or virtual organisms ("digital biology"[16]), artificial intelligences, artificial brains (on the way to a super-brain), artificial persons (programatically at least) and indeed also a "digital physics", though, for once, physics did not lead the way in the procession of digital sciences, the first chronologically and certainly in baptismal terms, being artificial intelligence, though it is reassuring to find that the usual "cultural lag" obtains inasmuch as Artificial Economics and even more Artificial Sociology (still in its earliest infancy) don't compare yet in their level of development with these fields. In a more fundamental sense, the engineer[17], philosopher and armchair revolutionary Georges Sorel had already argued forcefully a century ago that modern experimental science, in contrast to "natural philosophy", or "natural history", investigates not "natural nature", nature "in the wild", but "artificial nature" prepared for controlled laboratory conditions (in this analysis preceding and clearly influencing Bachelard); today, nature-simulation, and the engineering of virtual beings, has added a new technoscientific mode of artificiality, and all natural sciences are now truly "sciences of the artificial", in one or more of the major senses of the term "artificial"[18], sometimes in several or perhaps all senses, conjointly, including that of being "digital sciences", as we already have a digital physics, a digital chemistry, a digital biology, a digital science of organic and non-organic intelligence (of mind, of consciousness), and indeed a digital geology and a digital geography [19]. Perhaps one might say that the natural sciences proper are sciences of "computation in the wild" (as the phrase goes), that is to say the computation that takes place in natural beings in their pristine pre-cyborg state (in their *meatware* or *fleshware*[20]), including not only *la pensée sauvage*, but also *la pensée apprivoisée* of the very practicioners of the sciences[21], whilst the artificial sciences are sciences of the computation

directly engineered by us. Yet some of the eventual momentous outcomes of such computational engineering (AI, AL), with a dash of Darwinian evolution, are not expected to remain under our control, or within the confines of our understanding (the very point is that they will surpass our cognitive capacities), so these will be also, in a way, "wild" too, and that is the point of it, that is the beauty of it, the terrible beauty, some might say, or, better, the sublimity of what is to come (beyond the received versions of the "technological sublime").

A bold scientist has proclaimed, in a recent self-published 1,200 page bestseller, the advent of a computation-inspired "new kind of science", a science of rules rather than laws, as the dominant style of scientific knowledge-production, though it is not clear whether the author, the computer scientist Stephen Wolfram (creator of the software program Mathematica) will ever gain the accolade of a new Bacon, the herald of a scientific revolution, he may certainly be seen as one of the leaders promoting a cybernetic monoculture of the scientific mind. Wolfram has certainly made the most of the methodological lessons to be gained from cellular automata (first promoted by the mathematician von Neumann, whose legacy comprises many superb, yet poisoned, gifts), the virtual entities that have arisen in the prosecution of the Artificial Life programme: how with simple rules working on simple relationships, your programs can generate extraordinary complexity. Conversely, he holds that all processes, however complex, whether arising spontaneously in nature or through human intervention, may be seen as the final result of the application of simple initial rules. However, contrary to the excesses of scientism, he does argue that this complexity may be in some cases, unmasterable by current science, or what he calls "computational irreducibility": even if completely generated by definite simple rules there is no way, even in principle, to understand the system until the program is run (until it is all over, or until the end of time). Free will in humans would be a case in point: our actions cannot be predicted before they happen though if accurate prediction is impossible, even in principle[22], this does not negate the principle that such systems as humans are instances of deterministic systems (Ed Fredkin, physicist, inventor, successful entrepreneur, MIT academic, had advanced analogous views about the wide epistemological import of cellular automata and simple rules as generators of the most extraordinary complexity, much earlier, but he concentrated exclusively on physics, and did not set forth his views in a grand manifesto).[23]

Not only is the production of scientific knowledge increasingly simulational, science *in silico*, but the very subject of the production of scientific knowledge in general, and not only under present technological circumstances, the concern of metascientific inquiries of a computational and simulational kind. "Simulating science" is a cognitive enterprise of note: metascience itself strives to become a cyber-discipline, with its research into inductive "Bacon[24] machines" and other epistemic digital machines, promoted by H. Simon, among others, easier perhaps now that so much science is not only latently, but overtly, computational to an increasing degree[25]. Cyber-science is a natural topic for simulating science, or *meta-cyberscience*, but all scientific knowledge, such as Newtonian physics, falls within the domain of meta-cybercience or the computational philosophy of science. It is not just a matter of providing a rational reconstruction of past scientific knowledge in terms of inductive inference, deductive inferece or more recenty of abductive or retroductive inference (in Peirce´s sesne). It has also become a programme for advancing scientific knowledge today. Recently the periodical *Nature* published a paper on what the authors called the

"robot scientist", the isue of a combination of work on Artificial Intelligence in discovery software, or "machine learning" and on robotics, which can perform genetic analyses (in this case, the function of specific yeast genes), as accurately and effectively as a human and more cost-effectively than human scientists[26]. The automated system, once fed data (as a human readinga rticles on a given topic), originates hypotheses, devises experiments to test the hypotheses, runs the experiments on its associated lab robot, interprets the results as rebutting or corroborating the hypotheses, and restarts the cycle in the former case. According to the authors (and the editors of the journal concur), this may be a significant step twards the automation of some phases of scientific work, enabling at least many tasks of graduate students, research assistants, postdocs, be performed by "intelligent" scientific knowledge-producing robots. An editorial in *Nature*, in the same issue, commenting on the article in question, drew an analogy with the history of clerical labour in the service sector: with the mechanization of routine laboratory tasks, apprentice scientists will be freed for more creative tasks, allowing more time and energy to make the "high-level creative leaps at which they excel". This is perhaps a not very cheering analogy, since the historical record on the trials of clerical labour is very mixed indeed, though unwittingly perhaps their remarks suggest the need for a *theory of the scientific labour process* to complement the existing "theory of the labour process" elaborated for the industrial and non-scientific service sector: there is so much literature on knowledge-capital, on the capitalization of knowledge, on property rights for scientific invention that it would be pleasing if scientific labour (oddly invisible in the literature referred to, and indeed in much history, sociology or philosophy of science, the category itself altogether absent), not scientific capital, could be taken into account in a theoretical fashion. After all, the authors point out that the robot scientists or SciBots "can work all day and all night without labour costs" (this might be welcome too as saving time and money in drug development). Where will the process of mechanization of the scientific labour process, "the freeing of brainpower" end? Clearly, the automated science lab looms ahead, and, accordingly, the drive for "downsizing" in the ever-more capitalized, robotized, Automated Market University[27] may pick up speed.

Meta(cyber)science is construed as simulating science (a computational study of scientific knowledge production); cyber-science is by definition simulational; cyberscience simulates nature; nature, or rather the physical world in its entirety, at the quantum lvel, too, is, according to some physicists, like Ed Fredkin, J. A. Wheeler or S. Wolfram, itself a simulation or a computer program (not The One and Only World Program, but just *a* world program, one of the infinitely many that could have been run, and not the most necessarily the most elegant: the author of the actually existing, or actually running, world program could have done better, according to Fredkin- but how do we know until it is run in full?). Given these premisses, we may conclude that, on these terms, presumably, any and every scientific simulation is, necessarily, at least a simulation of a simulation, if not a simulation of a simulation of a simulation, and so on … Artificial or cyber-metascience is certainly a simulation of a simulation in the case of the cybersciences.

Philosophy itself, not least philosophy in the analytical styles, has now taken to computers and the Internet, replacing the Socratic dialogue and the live face to face seminar or tutorial by the new forums of electronic comunication, and may even become a cyber-discipline in other and perhaps more consequential senses as well, through systematic

reflection on cyber-science, on simulating science and the computational universe. In the current wave of technological enthusiasm fuelled above all by IT or ICT and its cognates, philosophy in practice has come to be characterized by some distinguished practicioners as a mode of engineering: so much for dialogicality, dialectic, hermeneutics, rhetoric, logic, synoptic ambition, aiming at "rigorous science", and other such concerns of recent philosophy…One might argue that in a technological civilization we need philosophy of engineering, not least the epistemology of engineering, and the epistemology of the the implementation of engineering in the real world of risk and uncertainty, as well as a critical inquiry into Artificial Science[28]. We need a critique of technological civilization, a critique of technoscientific reason, a critique of the technogenic world. Instead, we now have a proposal to turn philosophy into engineering, or reclassifying philosophy (as is now being done by some practicioners), whose etymology means the love of knowledge, as engineering (though not to be confused with the "knowledge engineering" in the field of "expert systems" which have been playing a substantial role in law and medicine), or a "science of the artificial", or another Artificial discipline or *wissenschaft*, Artificial Philosophy. It might be more relevant to turn engineers into philosophers, though it is true that a number of engineers since the early nineteenth century have developed significant philosophical views about the role and cultural import of technology. It has been claimed that such engineer-formulated philosophies of technology have been more optimistic, at least on the whole, than those works by such philosophers or other humanists that have addressed the questions concerning technology and technological civilization, but in fact this has not always been so, and at any rate many of them have been demonstrably aware of the profound ambiguities of the historic role in national or planetary terms of actually existing, effectively embodied, technologies (their technological optimism, when present, has often been associated with religious backgrounds, commitments and visions, and not just with secular concerns, or as the result of a purely secular or formally secularized technological utopianism). Even those, like Spengler, who enjoined their countrymen to become engineers rather than poets or thinkers (in a direct attack on the German self-image of a nation of *Dichter und Denker*) were not necessarily, by any means, cosmic optimists or expecting universal well-being to arise thereby, let alone salvation, to put it mildly. The engineers in Weimar and Nazi Germany who embraced reactionary modernism, the pursuit of technology in the aid of power and the master-race, and who believed in a deep congruence between the two, the "reactionary modernists" as characterized by J. Herf, illustrate the point that technological optimism of engineers could be very perverse. The most important philosopher (in the general judgment in Anglophone countries particularly, though some would demur) of the twentieth century with a background in engineering, specifically in aeronautical engineering, Wittgenstein, though he did not develop a philosophy of technology (though recently some of his followers have pursued the critique of the programmes and claims of Artificial Intelligence), was by no means intoxicated with the progress of technological civilization, even if he cannot be labelled a pure case of "cultural pessimism".

We may sum up a first overall impression of the changed map of the *globus intellectualis* that we face today in two crisp sentences coined within the last fifteen years or so by two very different American scholars. "*Information is everything*", according to a sociologist and student of Lacan, much concerned with the psychoanalysis of

computer use and organizational dynamics in the economy and not only (Sherry Turkle). "*Everything is information*": so have proclaimed many exponents of the technologies and metaphysic of information, including the mathematician, speculative thinker and science fiction writer Ruddy Rucker[29] (or, in the genre of ontological maxims popularized by Quine, "to be [something] is to be information, or informatizable). This palindromic informationalism, as we may call it ("everything is information" ="information is everything"), sums up, in two interconvertible slogans, that it would be an exaggeration to claim but perhaps not by very much, the dominant, or the hegemonic, self-image of the age (though not entirely perhaps that of the actual hegemon of the times).

Be that as it may, the word "information" is everywhere currently and this prestigeful ubiquity in the sciences and in science fiction (literary or cinematic), amongst the cybernauts and among the laity, warrants the title that the American theorist of rhetoric, and of sociey as rhetoric, Kenneth Burke ascribed in quite other contexts, in the age of warring ideologies, a "god term", and the cluster of associated concepts enjoys the status of a pantheon of auxiliary deities (or "auxiliary god terms") in this constellation. The world itself has been most economically summed up by a major contemporary theoretical physicist, J. A. Wheeler, in a compact string of four monosyllables: "*It* is a *bit*" (one may see this as sentence as the latest counterpart to the even more laconic biblical phrase *Fiat lux*, the Latin being shorter of course, through the resources of the language). Or, as another commentator has put it, "if (…) matter is essentially quantum [and of course it is], then matter *is* information [italics added]" or, "[t]he new primordial substance: not matter but *information* [italics in the original]": these are not, admittedly, statements that one will most likely find, at least in such blunt terms, in even the most up to date college-level physics textbooks, but they testify to the potency of what is perhaps the favourite or at the very least one of the most compelling of the prime "ontological metaphors" of our time concerning the most basic "stuff" of the world, among the scientifically well-informed and all those sensitized to technoscientific imagery[30] (other metaphors, ontological or not, have persistently attached themselves to notions of "information" since 1945, not least that of an "information waterscape"[31], or what one might call the *topos of oceanic information*).

It is not yet a central issue but one must note, nevertheless, that the concept of information appears to have assumed parity (or at least approaching it in the views of some leading physicists) with the concepts of matter and energy in physics itself – and that is as "hard" as you can get, science-wise, surely- whilst the concepts of matter and energy are quite a bit older. Obviously the concept of "matter", although very substantially modified in every epoch of physical science, is quite ancient by comparison, and the conceptions of atomism have had a lasting influence in natural philosophy since pre-Socratic throught (as well as a long, remarkable, independent history in Indian thought): the history of atomistic speculations (or "atomistic intuitions" as Bachelard put it), or corpuscularianism, critical to modern science, of matter-theory, or "hyletics", to use the term recently revived by Deleuze[32], or "materiology" (F. Dagognet), has naturally been the subject of extensive inquiries ranging over centuries and millennia. Even the concept of physical energy, whilst dating, strictly speaking, in its articulation in modern guise and acceptance in physical science from the 1850s (after decades of close engagement with the theoretical issues raised by the power-engines of the Industrial Revolution as well, to be sure, with immanent problems of the physical sciences *qua* sciences), and therefore almost a

century older, has a long pre- or better ante-history, in the currency of the concept of force in mechanics, in its constitution in "modern rational science" (Max Weber's phrase), even though contested in the recurrent controversies between the supporters of the rival schools of mechanicism and dynamism in natural philosophy, at any rate, a longer history which has already been related in considerable detail. Notions of force fields, or of plenist, anti-atomist intuitions going back to the Stoics, have provided a recurring counterpoint to atomism, or the corpuscularian outlook, a striking example of the alternation of "themata" in Holton's sense[33]. In any case, the basal triad matter-energy-information appears now entrenched in physical thought, when even twenty years, certainly thirty years ago this triad as defining the "stuff" of the physical world was not part of the common perception of scientists, whether physicists or others, and most certainly not of science popularizers (a job often done by ex-scientists or even intermittently practicing scientists), for since the twenties at least, reference was made essentially to the dyad matter-energy, though of course a great deal was made of the maximum velocity of signals, the velocity of light. Of course, at least since the "Maxwell's demon" thought-experiment was put forward in the third quarter of the nineteenth century, the relationships between energy/entropy and what has come to be known as "information" have been discussed intermittently by physicists, at first by classical physicists and later by quantum physicists in the nineteen twenties. Nevertheless, the appearance of information theory in the nineteen fourties suggested a reframing of the discussion of the seemingly intractable Maxwell demon paradox and the sense of how to go about resolving or dissolving it.[34]

Whatever may be the case in physics, it is undoubtedly the case, and hardly needs documentation, that, in the general currency of thought in our technological civilization, "information" (a term which we may use from time to time as an epitomization for the conceptual or perspectival galaxy indicated) has become so pervasive as to enjoy the status not just of a leading concept even one that has become the requisite of an increasing number of disciplines, but of a category, in something like the traditional sense of an absolutely fundamental, indispensable and commanding concept for systematic rational thought (it is perhaps a pity that Campanella's term "primalities" did not replace "categories"). Thus it appears to enjoy at least parity with such basal concepts or categories as space, time, matter, force/energy and the like, answering such basic queries concerning the *loci* or *topoi* of "where?, when?, why?, how come?, how much?, to what effect?, to what purpose?, made of what?", or exhibited in basic linguistic forms such as subject-predicate propositions (in Indo-European languages). As it is now pervading if not saturating our comonsensical understandings and daily practices as well as the institutional framework within which we have to proceed in all our transactions, it surely counts as a category in the Durkheim-Mauss sense (borrowed from philosophy, but most immediately from the neo-kantian critical rationalism of Renouvier[35]) as something overarching in our conceptual frameworks, and thoroughly implicated in our collective representations in the way we think and act, and cannot do otherwise (and indeed implicated in a web of social sanctions). For Durkheim and his collaborators, the repertoire of the categories of human thought appears to be fixed, but the specific determinations of the categories vary very substantially across social space and historic times and various classic papers were written precisely on these variations, such as Hertz on the privileging of the right hand as the enactment of social space-differentiation, Hubert on time-marking as sacred

or profane, and the religious matrix of temporal classificatons, Durkheim and Mauss on symbolic classifications (the conceptual, value-laden, sanction-bearing cross-classifications of all things that make up operative cosmologies), and Mauss on the category of the person.

For Strawson, "our conceptual scheme", by which he means "our categorial scheme" which makes up our common sense world, has no history [36](Oxford philosophers liked to say "we" and "our" in some all-inclusive, pan-human sense, but this goodfellowship somehow excluded deviant Continental European metaphysicians, against whom they always seemed to be writing, though they have had their own home-grown deviant metaphysicians, even in the same city, in the same university). He did recognize that there have been thinkers whose systems were clearly at variance with the ones that supposedly define our common sense, and he called them "revisionary" or "prescriptive" metaphysicians (appealing or not to "deviant logics" such as dialectical logic, para-consistent logics, quantum logic and so on). However, he did not appear to concede that in Western civilization our conceptual/ categorial scheme may have undergone shifts at least in the over-all distribution of emphasis, on the legitimacy of diverse categories, in their cotenability, and in the admission of categories which would not fit in comfortably in the received overarching conceptual schemes of the epoch or the culture. In this he appeared wholly at variance with the "revisionary" proposal of "metaphysics as a historical science", enunciated by Collingwood in 1940, according to which each epoch of thought was circumscribed by its own "constellation of absolute presuppositions" (called "absolute" for they are not explicit premisses of any reconstructible axiomatic propositional system, and they cannot be articulated as long as they are operative, as long as they shape our thinking). Although this is not a topic of investigation in this paper we may advert that we do not subscribe to the categorial immutability thesis of Strawson nor to the radical incommensurability or unbridgeability thesis that is all too easy to read, rightly or wrongly, in Collingwood (for this thinker we can never, by definition, articulate fully, if at all, our own Absolute Presuppositions; tht cn only be done by others, when our epoch is over) [37]. We are closest to the Durkheim-Mauss position of categories-with-a-history, except that we also concede the emergence of new categories, for the stock of categories is not given in advance, nor indeed a priori, and no attempted transcendental deduction of the minimum set of irrecusable categories has ever been successful, though usually such attempts prove not unilluminating. Today, of course, we have into account not only cross-cultural variations and how we may still cleave to the "epistemological unity of human kind" in the face of these variations, unless we yield to epsitemological relativism of a fundamental kind, but also the problematic of the non-human cognitive, ratiomorphic or "intelligent" beings, and the comparisons between human epistemology and "android epistemology" (a new branch of comparative epistemology, already supplied with cllections of readings). Also, this approach tacitly recognized, in part, the importance of valuations and valuational hierarchies, and the sanctions attached thereto, in category-work: a point made forcefully by Rescher in speaking of "evaluative metaphysics", the overall axiology of the world, subsuming the Augustinian *ordo amoris* in a wider axial framework, encompassing non-human concerns and realms of being[38].

At any rate, in these terms, there has been a veritable large-scale *categorial shift*, if not a "categorial revolution", in the last few decades, involving at least the restructuring of the relatively slow-changing categorial understandings to admit a

new category or primality. The implications for the interrelations of the categories of space, time, matter and energy on the side of the physical sciences we have already hinted at. The gravest implications, because they bear more directly on our "natural attitude" (or "natural stance") concerning life, stem from the advent of molecular-informational biology and bioinformatics generally inasmuch as their turn towards biological engineering was one that no discipline in the past managed so quickly and with such portentous and far-reaching implications (this may be disputed, of course). We are offered a curious mix if not a perplexing alternation, of genetic determinism and genetic interventionism (therapeutic or preventive, somatic or germline, in human subjects, transgenetic new organisms in agriculture, fisheries and husbandry), or, as it is sometimes put, "brute genetic determinism" of simply taking the consequences, and "Promethean genetic determinism" of manipulating pristine genes and manufacturing "wonder genes" for our well-being and our empowerment (for many purposes, such as eliminating crime and violence, by eradicating its genetic basis, something which is very often claimed, despite the startling naïveté). On the one hand, the judicial-astrological sounding pronouncement by the geneticist James Watson, co-unlocker of the Code of Life, that "our fate is not written in the stars, but in our genes" (fate, not destiny, though destiny would have been less contentious since destiny can be assumed in terms opportunities to seize the right moment, the *kairos*, for making the best of things, and fate can only be endured without recourse, fate can only crush), and on the other, that biotechnology, by virtue of its access to, and command over, genetic information particularly, can empower us to change, to redesign, to reengineer, to reprogram, life-forms, our vital properties too, consciously and deliberately, in substantial ways, to "our own" specifications, under the guidance of qualified "biocrats", with and through the market, can induce giddiness on even the sanest.

Similar developments may yet ensue from the informational understanding of mind and consciousness, with the strain that the implications which are being drawn and strenuously promulgated of what is standardly called "eliminative materialism", which might be better explicated as "eliminative ontological materialism", or radical physicalism, from the conjunction with neuroscience/neurotechnology (ever more sophisticated brain scanning)[39], or even the slighly weaker thesis of epiphenomenalism, which date back to the mid-nineteenth century, are placing on "folk psychology", that is to say, our commonsense conceptual scheme regarding our mental life, our minds, our personhood, our basic self-regard, at any rate what I conjecture to be the prevalent commonsense conceptual scheme in terms of which we see ourselves as necessarily, even essentially, creatures of desires and beliefs ("propositional attitudes"), or in another lexicon, of intentionality (in the neoscholastic sense of Brentano of directedeness towards objects, absent or *abstracta*, possibly nonexistent, fictional or logically impossible ones, often regarded as "the mark of the mental") and as capable of free decisions as well as subjects of qualitative experience or, in the standard terminology, qualia[40]. This version of self-designated materialism is of course much stronger than the most influential version of materialism in recent times, that of non-reductionist "emergent materialism", which grounded mental life in physical or biological reality but did not deny its specific features of qualia, consciousness, even possibly rational volition[41].

Of course all these currents of thought also profess a kind of "eliminative (ontological) individualism" (that they subscribe or indeed take for granted *methodological* individualism, the dominant strain in contemporary social science in

any case, goes without saying) inasmuch as they quite clearly reject, overtly or by implication, any attribution of ontological status or irreducible predicates or irreducible higher-level laws to groups, collectives, institutions or cultural entities or cultural wholes. There seems to be a dissonance with the significant support for ontological holism regarding social or cultural wholes, social or cultural entities, in "analytical metaphysics"[42], even if the bulk of sociologists, and other social scientists, seem to have been intimidated into professing methodological individualism, which often seems tantamount to subscribing to *ontological* individualism as well, even though it is generally conceded that the methodological thesis does not entail, or logically necessitate, its ontological counterpart (or, for that matter, its political or, more generally, axiological counterpart), or vice versa, though they may often be conflated, and it is of course licit to hold them together so long as they are kept analytically distinct. Of course there are approaches to the metaphysic and methodology of social theory which purport to be neither individualistic/atomistic nor collectivistic/holistic, since the "relational realism" of Renouvier at least[43], which is akin to what has been more recently called "relational holism", though this Third Way tends to collapse into one or the other of the poles of individualism and social holism, just as methodological individualism often collapses into reductive psychologism, but in any case this possibility does not seem to be entertained by the eliminativists.

The hard science informationalist physicalists would certainly eschew any hints of the "Objective Spirit" as anything more than the palest of ghosts in the global complex of information-machines-in-the-Net, though in fact the "*netaphysics*", or perhaps better, the *netametaphysics*, of Pierre Lévy, may seem on the verge of bringing the Objective Spirit back, or at any rate something like it, in an even earlier incarnation than the Hegelian one, as the analogy he pursues with the "active intellect" (*intellectus agens)* of Aristotle and of Averroes's interpretation of Aristotle ("Left Aristotelianism", Ernst Bloch called it), makes clear though he is rally more taken with Avicenna. These alleged implications also mean the potential subversion of the category or primality of the person[44] (or the rational being in the Kantian sense, a being endowed with pure and practical reason) which has been crucial to liberal democratic civilization and indeed to the presuppositions of the criminal law and the imputation of legal and moral responsibility in every Western society, and to our constitutive self-understanding as individuals/persons in the epoch of modernity, of the *homo aequalis* of late Occidental civilization, so cherished in all official discourse of the democracies.

To receive the category of information in the life-sciences, the human and social sciences, not so much per se, but rather in the specific way that has been taking place, carries quite a metaphysical baggage. For it has come packed together as one seemingly indivisible whole with the metaphysical claims typically associated with the information-pushers, or shall we say, with the information/computation-centred metaphysical, scientific or what we may call *technological* research programmes (borrowing respectively from Popper and Lakatos, and extending the Lakatosian approach to the history of technology) in the ongoing scientific study of and technological enterprises concerning life, mind, consciousness and persons. Now it is not at all clear that we can subscribe to these claims and still coherently call ourselves committed members of a liberal civilization based on what Durkheim called the "cult of the human person", the respect for the person ("respect" in the Kantian sense, as something partaking of awe) for the sacredness and integrity of the human person, of

generic personhood, the core of the overarching civil religion of the national versions of Western civil religion, underlying and grounding the language of moral and legal human rights, so pervasive, if not downright inflationary, in recent decades. At any rate, we would have to work out how to reconcile the respective presuppositions and implications, or perhaps learn how to live in two irreconcilable worlds, the true one of "scientific materialism"[45], and the illusory one of belief in libertarian free will and respect for persons (presupposing a positive ontological status for personhood), which surely cannot be kept wholly separate in a civilization so committed both to the pursuit of scientific and technological advance and also, at the same time, to the upholding and pursuit of human rights and liberal democracy.

In informational-computational-cybernetic terms it has been a regular practice to embark on "revisionary philosophical anthropology", challenging the very idea of personhood, as understood in anything like a broadly Kantian fashion. Pursuing these depersonalization goals, or at least outcomes, it has been proclaimed by distinguished scientists/mathematicians that "we are all zombies", "we are all cyborgs" and "we are all Darwin machines", slogans which we will proceed to discuss briefly.

If "we are all zombies", as the widely-read informationalist philosopher of mind Daniel Dennett indefatigably proclaims, enjoining us to lose the scales of our illusions about ourselves, to see ourselves as we really are, and cannot be otherwise[46], we cannot be free agents (and indeed since zombies serve as liminal beings between the living and the dead, perhaps not agents at all, in the conventional understanding). Though this exciting discovery is claimed to flow from cutting-edge science, we all know that similar implications were drawn very forcefully, with comparable enthusiasm, by major schools of experimental psychology at least since the beginning of the twentieth century and we have been repeatedly advised to deliver ourselves of the burden of putative libertarian free will and self-attributed "dignity" (another Kantian term) of human beings[47], by the teachings of Pavlovian classical conditioning, Watsonian molar behaviourism[48] and Skinnerian operant conditioning. All these research programmes were also conceived as forms of psycho-technological utopianism, promising to bring about painless large-scale social reform if indeed not the advent of New Humans, though the scientific transformation, pedagogic (via infant- and child-rearing, schooling and training) and therapeutic, of human beings, conditional on losing our illusions about freedom, responsibility and dignity, incompatible with the scientific view of the world. They were all very well-intentioned, they have all helped some human beings and ameliorated some social practices, in limited fashions, as well as being instruments of power and deceitful persuasion, but the doctrines or methods would not now be considered to be endowed with anything like the cognitive or technical capacity to realize their aims, despite their confident promises (the point is worth noting, taking into account Dennett's fondness for the word "engineering", in line with current trends).

"We are all cyborgs" according to the mathematicians J. Cohen and Ian Stewart in a recent work, who record this with unmistakable glee, though perhaps this should be taken not quite literally, but only proleptically, for it is hard to see ourselves as already cyborgs, in any strong sense of the term, with the best will in the world, and as uttered in the spirit of a self-fulfilling prophecy. Oddly enough, such claims appear to neglect the actual origin of the concept of cyborg (for "cybernetic organism"), invented by two scientists working for NASA as an alternative to genetic engineering (not a very realistic possibility for the immediate future at that time, though already much talked about by geneticists and

other biologists as a grandiose project that would be realized on a large scale, and over a wide front, in a matter of decades), to design modifed humans that could be fit for space travel and residence in other planets, literally fit for space not for the Earth, fit for other worlds, not for this one, not for a richer life on this planet. If indeed we were all cyborgs now, we could not also be as human as we still appear to be to the naked eye, or at least remain human in any folk anthropological sense that as prevailed hitherto (there are trivial senses in which we may be said to be cyborgs at this hour, but the scholars in question mean more than that: several persons have claimed to be cyborgs right now, on the grounds that they have had microchips implanted in their bodies or their brains[49]). The process of cyborgification, of becoming ever more fully cyborgs, is certainly on, perhaps succeeding the arrested "process of civilization", but no cosmic law, no Supreme Technological Imperative, will compel us to go through every rung in the ladder of cyborgification, just as we are not compelled to follow the process of transgeneticization until we turn into New Humans, until we attain genuine complete cyborg status. We are not, to be sure, compelled by any directional law of evolution (even if any such things obtained in fact or could obtain in principle, owing to fundamental empirical considerations or to conceptual warrants), but the drift of creeping cyborgification (and what Dewey called "the fascination of all too easy surrender to fatality"[50]) could conceivably bring about the same result in due course as any "directional law" (M. Mandelbaum), "functional law" (G. A. Cohen), or orthogenetic law or trend towards mechanizing humans. Note that this view, though formally in the indicative mood, clearly involves a confident prediction and an impatient expectation that the mechanization of humans, the tranformation of the organic human into the inorganic-electronic-mechanical, is the only way forward for human beings, and in any case this fate cannot be resisted, and indeed should not be resisted, to spare us much pain. They exemplify an important pattern of argument characteristic of much utopian social thought, not least in the socialist tradition, but which in recent years has been most forcefully exhibited in technological manifestos and the voices of cyberprophets: it is to treat what is to come, what is expected to be inevitable, good and most knowledge-embodying, along a master trajectory of technological development, as already present in some essential fashion (so the future will be more of the same: "we are all cyborgs" now, and in the future we will be even more so). This is a version of what Kenneth Burke called the "temporalizing of essence", in this case an application of the trope of prolepsis, a vision of the future as encapsulated already in the present, and thereby vindicating it. Some of us remember how the sociologist C. Wright Mills, writing in the 1960s, savaged the "cheerful robots" of his time: he did not anticipate the coming of the "cheerful cyborgs" (no other kind seems to be contemplated by cyborg enthusiasts, melancholy cyborgs not being envisaged), let alone that of the cheerful sirens luring us into the cyborg age, in our current technological odyssey, ostensibly on the grounds of its helpfulness in dissolving patriarchy and like ills[51].

We are all merely advanced "Darwin machines", or, in other words information-processing biomachines, subjected to selective pressures, according to Henry Plotkin (and in some ways this is straight current orthodoxy). But we are inducing, we are currently engaged in indefatigably promoting exponential and indeeed, more rigorously speaking, super-exponential, hyperbolic information-processing growth in our auxiliary intelligent machines with the aim of bringing about the advent of *autonomously* intelligent, ultra- or super-intelligent machines. We

are, unlike all other non-human Darwin machines that there have ever been, thereby drastically and unprecedently modifying, consciously an deliberately modifying, our biotic and abiotic selection environment, to render us superfluous, and certainly to generate beings that surpass us in cognitive capacity. No other Darwin machine has ever been known to do this, or even to conceive of it. The historian of ideas B. Mazlish has long been advocating the thesis that the the emergence of non-biological intelligence, approaching the human level and beyond, involves a discontinuity in the human self-image so profound, so far-reaching in its range of implications, as to involve an upheaval comparable only to the Copernican overthrow of our central place in the universe, Darwin's establishment of our continuity with the animal kingdom, or Freud's uncovering, or at least glimpsing, of the depths of the underworld of human motivation and mentation[52]. The general outline of the key blows that have been struck against anthropocentrism in the modern world seems plausible, but a few comments are in order. I am not sure whether the Freudian discovery would now generally be placed on a par with the others; there was a time not so long ago when Marx's purported unveiling of the motive-forces of history behind the backs of the putative agents, would often be ranked with Darwin's and Freud's exposures of fundamental, previously unknown, truths about human beings (in fact "Darwin, Marx, Freud" was a trinity of some weight in Western intelligentsias from at least the thirties till the sixties, as revealers of the most important truths about human beings, though only Darwin now enjoys the kind of ascendancy over the Western intellect that was once also enjoyed by the other two, whilst "Marx, Durkheim, Weber" still lingers as the canonical Founding Fathers triad among sociologists, probably a legacy of the Cold War, though for how much longer?[53]); Nietzsche would surely be a strong claimant- perhaps the strongest such claimant- today for a place in this canon of supreme disabusers and humiliators of man, with his pitiless exposure of the unwarrantedness, and radical unwarranteability, of all our epistemic and moral pretensions, and we may note, finally, that the last discontinuity in the list alone carries no proper name (not the least attractive feature of this revolution…revolutions should not be eponymous). But whether we are dealing with the third or fourth or fifth discontinuity of this generic sort, it is no wonder the cyberintelligentsia claims we must now be poised on the threshold of trans-humanity, and a very good thing it is, and not too soon (there will be no more discontinuities after that, for humans at any rate, if only because there will be no more humans).

Actually both Dennett and Plotkin, but also many other scientists and popularizers today, subscribe to what one might call *Darwinian informationalism*, that is to say not just to evolutionary epistemology of a Darwinian kind, but to *computational* Evolutionary Epistemology (ealier versions of evolutionary epistemology were not so, and it took three or four decades after the start of the computer evolution for this programme to be clearly articulated) not merely as a grand working hypothesis, but increasingly as a world outlook in which the informational-computational construal of organisms and minds is bound up with strict neo-Darwinian selectionism or pan-selectionism (minimizing the importance of "genetic drift" or "founder effects", for example, or, more contentiously, neutral evolution at the molecular level, a kind of fundamental randomness untempered by selection, or the contingency of evolution in the neo-catastrophism of Gould and Eldredge) to account for all evolutionary processes in organic and mental life so far and to construct scenarios for the ascent of intelligent machines into the post-human condition (the A-fields can also be designated as

"evolutionary": "evolutionary computing", "evolutionary robotics", "evolutionary hardware", "artificial evolution", "artificial Darwinism", etc., are all locutions to be found in the literature as banners for research in progress). Already in the emergence of "evolutionary epistemology", as a named field of inquiry a couple of decades ago (in practice of course is much older, though not always in an exclusively Darwinian fashion, and went by such names as "genetic epistemology", even before Piaget, whose name is now associated with it, or "comparative epistemology", taking into account phylogenetic and ontogenetic findings), Darwinism, or rather neo-Darwinism, as currently understood, became the template for a master schema of explanation applicable to any beings endowed with any kind or degree of cognitive faculty and indeed throughout the entire ambit of Popper's world 3, the world of the products of the human mind, from mathematical theorems to musical compositions. In fact, it has been applied to practically any entities in any domain of reality, physico-chemical, mental, social, cultural, material-cultural, technological, epistemic, as well as biological, in all of Popper's three worlds (though pre-eminently in world 3), so long as they can be encompassed in terms of variation, replication and selection. Crucially, the "selection conditions" must be independent ("decoupled") from the "variation conditions", for, if this crucial constraint is dropped, you get non–Darwinian, especially "Lamarckian" versions of evolution[54], which today are definitely out of favour, above all in biology, strictly taboo, strictly unthinkable, though, according to historians of the subject, they predominated in the general climate of Western thought, even after Darwin, until quite recently, and were important though not hegemonic even in professional biology for almost a century after the publication of Darwin's key book in 1859 if we are to beleve the claims made at conferences commemorating the centenary of *The origin of species* that "a century without Darwin is enough"[55]!. Moreover, the schema applies also to any virtual entities as engendered in computer simulations, purely within the computer world or shadowing every existing "natural kind" or type of entity in any domain of the real world, natural or cultural, what one might call the "virtuals" (cellular automata), and merely so, and what one might call the "virtual somethings" (virtual bacteria, virtual animals, virtual organisms of any kind, virtual cities, etc.), that is, the virtual counterparts of entities to which we have independent access in other ways than *in silico*. An important field where curiously an evolutionary perspective had not been systematically applied is that of "evolutionary medicine" which asks Darwinian-kind questions more focally than ever before regarding diseases and pathologies (especially in the human case).

Evolutionary perspectives were not paramount in the earlier versions of the cybernetic world-view, and there has definitely been a shift towards evolutionary perspectives in it, not only in the informationalists' interest in evolutionary processes of (natural) life, but in the turn to thinking in evolutionary terms in all the A-programmes, so much so that Darwinian selectionism seems inseparable from any and every project or programme in Artificial Science or Synthetic Science, though in fact, in every field of inquiry today claims are advanced that they exemplify Darwinian change even without reference to digital modelling and computational glossing, whether in cosmology with L. Smolin's "Darwinism of universes" (the fittest universes survive, tough the selection mechanism is somewhat hazy), in the suggestions of a "microphysical Darwinism"[56], and everything in between, as in the case of neurology, amongst many other fields that could be mentioned, with the "neural Darwinism" of Gerald Edelman. The latter,

inparticualr, could be called a kind of *reflexive Darwinism* or *recursive Darwinism*: each level of aggregation is accounted for in selectionist terms, but so is the next level down, that of its constituent entities, and so on, all the way down. Conversely, there have been attempts to vindicate Darwinian explanations of biological evolution by running computer simulations, to let the "science" or at any rate the methodology, of Artificial Evolution come to the aid of the science of natural evolution, with so many missing links in the fossil record: the case of the human eye, a notorious difficulty for Darwinian explanatory hypotheses, does not suggest that such help may be forthcoming, for the experiment cannot, it seems, be credited, but work in Artificial Evolution or Artificial Darwinism goes on with undimmed enthusiasm. Note that with the advent of "evolutionary programming" particularly, letting virtual change take place in ways not designed, even unexpected, re-enacting as a precept the formula "the results of human action, but not of human design" (the phrase of the eighteenth century social theorist Adam Ferguson,[57] which Hayek has vindicated as absolutely lapidary, and summing up one of the key lessons to be learnt from the Scottish Enlightenment), the now-evolutionary computationalists are departing from the conventional understanding of engineering, which stresses conscious design above all, and seeks to minimize undesigned consequences, so it is somewhat surprising to see the constant invocation of engineering as the paradigm to which respectable cognitive endeavour should aspire. There is a tension here as throughout informationalist evolutionism, between the emphasis on instructions (programs, genetic information) and on natural selection, despite the conjunction of the two modes, for some ultra-darwinians woud like to push the explanatory power and the creative role of selection (a favourite theme of a major mathematical theorist of evolutionary biology, Ronald Fisher, was the "creative role of natural selection"), as far as possible, iteratively, consequently minimizing the role of pre-programming at any time in evolutionary processes (in some ways a replay of the disputes about the relative importance in ontogeny of preformation and epigenesis in biological thought until the late nineteenth century at least). There seems to be a kind of tacit variant of a variety of Ockham's razor here, one might call the *Ockhamite selectionist rule*: never explain the properties of any evolutionary entity in terms of in-house, pre-existing, wired-in, information programs, until you have tried your utmost to explain them as the uphsot of iterated selection pressures (in the contrast between "instructional" and "selectional" models, such as formulated in neuroscience, between models that depict the explananda as the unfolding of preset programs, and those that account for the structures to be explained as the result of iterated selction pressures on non-programmed entities, the latter are the favourites). It is not clear how far this methodological selectionism is to be carried out, and in any case, it is often applied somewhat selectively, so to speak.

Dawkins wrote of organisms as "vehicles" for genes, others have written of bodies as "vehicles" of brain-information, leading, in their conjoint form, to what I have called in another paper [58] a "*double-vehicle*" view of human beings. On this account, the organism appears as definitely secondary to both genes and memes though important as the carrier, though the essentially transient carrier or material support for them (the genes at least like "germplasm" for Weismann, qualifying for "immortality"): the living, acting, suffering organism as more than a vehicular entity, as a device for holding and transmitting or receiving genes and memes, as an interactor, as a learner, as a social being other than as a player of games of strategy, is

lost from view. Concerned about the passive aura of the term "vehicle", the philosopher of biology David Hull has suggested that we replace this term in the Dawkins formulation, by "interactor", to lend something more like natural agency to the entities in question, for "vehicle" does suggest utter subordination and heteronomy, but keeping "replicator" (the biologist-philosopher M. Ghiselin has suggested replacing "replicator" by "replicant", whose copies are "replicates"). To speak of interactors and replicators may be an inorovement over vehicles and replicators, but I am not sure whether it would not have been preferable to replace "vehicle" by (natural) "agent" instead of by "interactor", for one can interact witout design or active behaviour, and in any case the interactors in question, as much as interacting in a wide sense with the abiotic and biotic environment, in a true Darwinian spirit, mostly engage in perpetual competition, in the unceasing struggle for life and for reproduction against conspecifics, predators, competitors for scarce resources, so "*agonist*" might well have served even better, though no terminological improvement cannot redeem the schema from its neglect of energy metabolism, the thermodynamics of life, on the one hand, and proper consideration of signs and meanings, of bio-semiosis and not just bio-informatics, which is misleadingly collapsed into genetic information only (the "interactor" as unceasing "*interpreter*" of signs of every kind, classifiable in many different ways, as Peirce brought out)[59].

Since genes are the paradigm-case of natural "replicators", or information-machines "in the wild", as the expression goes, copy-makers par excellence, by induction at any rate, with the "errors" being induced by mutations of one sort or another, the search has been on for counterparts to genes in other domains, and Dawkins himself suggested "memes" for the mental (and indeed "inter-mental", since they can be passed on from person to person, horizontally, in an epidemiological-like, non-reproductive fashion, to kin and non-kin, and that is really the point, rather than their replication within the individual psyche) counterpart. "Memetics" has emerged as a research programme (a degenerate and degenerating scientific research programme, some would say) which falls under this rubric, although much less impressive as yet than the older A-programmes (AI, AL), and so far with little practical technological work on offer. It seems to have been conceived in a fit of amnesia, for a rather similar programme had already been advanced by the sociologist-philosopher Tarde a century earlier. For this thinker, imitation or replication of beliefs and practices, speech and affect, through custom or fashion, dogmas and opinions, were the very stuff of social or as he preferred to call it, inter-mental life (he was an ontological as well as a methodological individualist, like Dawkins, one may presume).

These are only a few examples of the explicit, currently fashionable variants of "humans as machines" theories or metaphors. Such theories or metaphors have been formulated many, many times before the current cybernetic-informational versions, which may well be followed by others, as long as the sciences proceed. Be that as it may, they accord with the propositional function:

(M) "we are (all)____machines [automata]"

"We"= humans, and if humans, also animals (in fact, all organic beings), where the dash may be replaced by some classificatory term or other (simple, mechanical, power, electronic, computational, finite state machines, etc., Bacon machines, Darwin machines[60], or mixes thereof, or, elliptically, dropping the explicit term machine or automaton[61], by cyborg, robot, cybot, android, or cyborg-like, android-like, etc.) according to the technological epoch, or the conceptual scheme

favoured by this or that school or this or that discipline, is one of the most powerful, pervsasive and addictive topoi of Western thought, in science and philosophy. In the strong version this means "we are (nothing but) ___machines", in a weak version something like "[let us see how far we can learn by positing that] we are ___machines", but the strong version always leads. Kurzweil has written about "spiritual machines", but he means nothing like the conventional understanding of "spiritual" and really no more than very, very even supremely, "intelligent". The "spiritual automaton" of the seventeenth century was a different matter, an *ensouled* automaton, though the similar descriptions of electric machines, electricity or even aeroplanes, at least in the air, as more "spiritual" machines than the earlier ones, quite frequent amongst reflective engineers and commentators on industrialism when energy machines ("power machines") rather than information machines ("smart machines") dominated our imagination, betray the long-standing prepotent propensity to regard some machines or technological processes as somehow less mechanical, less material, than others, or more positively stated, as deserving the accolade of "intelligent" or even "spiritual" machines, and engaging to some degree a variety of "reactive attitudes"[62] (such as admiration, awe, resentment, fear, etc.) we used to have towards the world of spirit and spirits, perhaps a version of "technological fetishism" in Adorno's sense (who added it to the classical marxist concept of "commodity fetishism"), engaging another variant of the "rhetoric of the technological sublime" which has constantly exalted the conquest of space, time, matter and nature by machines (in the wide sense encompassing structures as well as machines in the narrow sense, and far-flung, large-scale technical systems like the National Grid, or even the WWW), their might and potency, their intimations of some power beyond ourselves, unleashed by us, even though initially of our own devising. The variable, placeholder or dash in the propositional function (M) will no doubt go on being replaced by other modes of machinehood and the "study of humans" translated into robotics, androidology, cybergology, cybotology, etc., or, if you like, of Artificial Anthropology (AA), that "science of the artificial" which deals with cybernetic or virtual humans and humanoids, which I have called elsewhere "ultra-anthropology", to which I will add now the recognition of another cognate "science of the artificial","para-anthropology"[63]. By "ultra-anthropology" I mean the study/invention of such artificial, cybernetic, ratiomorphic beings created by our info-technologies, at one or more removes, for evolution is supposed to lend a hand, visible or invisible, through a sequence of stages of improvement, which aim not only to attain parity with, but to surpass and overleap human-level intelligence. As in the case of exo-biology so far, the class of such known beings is as yet null, though not necessarily so, but the subject of very interesting thought-experiments and indeed actual designed steps to such an eventual creation. Such proto-versions as may be designed will be partly left to the course of evolutionary change, as already tried out in "evolutionary programming".

. We can also play, if the pun be allowed, with the notion that we are or could become, or should become "pleasure machines", "experience machines" (Nozick), or whatever, as analysts of utilitarianism, in academic prose or dystopias, have done to accomplish a kind of reductio ad absurdum of psychological or ethical egoistic hedonism, or even the ideal of the public well-being in hedonistic terms, though "paradise engineering"[64], the maximization of hedonic satisfactions through every technology available (though some that have been available for decades have not been resorted as much as one would expect, such as the stimulation

of the pleasure centers of the brain[65] though perhaps the recently discovered, or at any rate recently announced "happiness hormone" might catch on) and yet stay alive, has been seriously proposed amongst cyberlibertarians[66]: no longer the "Art of Living" (as John Stuart Mill put it), but the engineering or the cybernetics of good living or at any rate of pleasuring, or at least, as current exponents of "painism" (a form of negative utilitarianism) would have it, of unpaining, of analgesic engineering, of the complete elimination of pain, of the capacity to suffer pain, through genetic engineering if need be, as well as any other pertinent technology. Yet in the more retarded sections of humanity no-one would believe that we can dispense with art or bricolage in these mattters (in fact no form of real-life engineering implementation can wholly forego a degree of bricolage, or tacit and experiential knowledge), or can elude the fortunes or misfortunes of good or bad "moral luck" (B. Williams), or, in Sartrean terms, the "facticity" of our undesigned, unchosen, irrevocable inner or outer circumstances, which cannot be willed away by any means whatever, and whose non-recognition is a source of "bad faith" (recall that Sartre denied the existence of the unconscious). In any case, it seems that, whatever the current scientific fashions, whatever the prevalent machine models may be at any given time, mechanical, iatromechanical, energeticist, thermodynamic, hydraulic, electrical, electromagnetic, electrochemical, biochemical, atomistic, macromolecular, behaviouristic, cybernetic, informational, analog, digital, hardware, software, human beings (and other animate, sentient, intelligent natural beings) are always presumed to be subsumable, for scientific purposes, for the sake of the "explanation, prediction and control" of our behaviour, solely and exclusively under the rubric, or the "root-metaphor" of machinehood. The question is not so much whether we are machines or not, or nothing but machines, for the standing presumption appears to be that we are indeed nothing else but machines (or, that there is no fruitful scientific way to proceed but to take this path, and only this path of inquiry, to the utmost consequences), but simply what *sort* of machines. It seems that in the West, whatever the fashionable ontological metaphor for mind in any given period, it must belong to the Great Machine Family, to be followed by another one, another generation, as it were, of ontological machine metaphors, once its proven inadequacies have produced too many anomalies, or in other circumstances of "paradigm-change", to use a fashionable, but deplorable, terminology, and so on (our ordinary speech, our folk psychology, still betrays the deposit of figurative expressions from earlier variants or strata of the mind-machine ontological metaphor, although for neuroscience it remains incurably animistic, and thus to be "eliminated" altogether, to be replaced by the authoritative, non-animistic, strictly materialist, scientific picture of our putative minds)[67]. The animal-machine motif may have preceded the man-machine one in Western thought, but today, since zoophilia is perhaps stronger currently than human species-philanthropy (concern about the survival of the species, as distinct from affection for and benevolence towards particular human beings, or a subset of human beings, with the future innonimate generations as the most powerless, and the weakest in their claims on our consciences) being animals, if "rational dependent animals" (for the philosopher A. Mc Intyre) or "moral, believing animals" (for the sociologist C. Smith[68]), with an inescapable moral and spiritual dimension (the vagueness of the terms does not imply that they are senseless), that needs to be addresses and not simply bracketed or subjected to some scientific "universal acid" (as Dennett famously called Darwinism), would be an improvement on the exclusive subsumption of human

beings under one or another variant, past or present, under the general rubric of machinehood, or as a determinate occurence of the determinable "machinehood".[69] Or perhaps, tautologously, but not irrelevantly, simply humans, albeit humans whose very being, paradoxically combining the ontic and the "meontic" (as existentialist thought has adverted, in Berdyaev, Tillich or Sartre), being and non-being, solicits the permanent possibility of bestialization, of "pseudo-speciation" of other human types or groups, of dehumanization, of self-annihilation, of the utmost self-deception or "bad faith" (through mechanization or in some other way) under the guise of "transcendence" through technological self-transformation, or through endowing nonhuman, nonsentient machines with the cognitive capacities to surpass us, to exceed, and by far, the utmost reach of natural intelligence, and, so it is argued, thereby be fit and ready to take over evolution in our stead. Though the question of whether physical systems are all machines, whether quantum phenomena are both physical and non-machine phenomena, is also one that is addressed in current discussions, it is true that, in the main, this type of consideration is regarded as irrelevant to the issues addressed by the computational, cybernetic, exponents of machine intelligence, machine minds, machine consciousness, of "spiritual machines"[70], for, by definition, they have not given up on the power and the glory of machinehood.

Notas

[1] See the excellent work by Slava Gerovitch *From newspeak to cyberspeak: a history of Soviet cybernetics* Cambrige Mass., 2002. The author refers to cyberspeak as a carnival language, as an instrument of freedom and as "the universal language of capitalism and communism". This most informative work shows how the technological utopianism associated or reinforced by the technologies of information and communication and especially the theoretical vision of cybernetics was not by any means restricted to the the liberal-capitalist world, but to a significant extent shared by both worlds, Soviet and American.

[2] Leibnitzian binary arithmetic, Boolean algebra, and the Fregean predicate calculus may be cited. Actually, binarism was strenuously advocated by the fanatically anti-Aristotelian Ramus (who exerted a substantial influence throughout the whole of the Protestant world in the sixteenth and seventeenth centuries): a sixteenth century Ramist logician even stipulated a binary classification of tropes, as comprising basically metaphor and metonymy, precisely the classification that Roman Jakobson advocated with such verve in contemporary semiotics, and which was widely accepted in structuralist movements in semiotic anthropology and elsewhere, and is still influential. The whole Ramist approach – a purported "revolution", a Reformation of the intellect, supposedly replacing all of Aristotle (whose intellectual authority led the poet Donne to call it "the longest tyranny") - to logic and rhetoric (still crucial disciplines in university education, as components of the trivium, the foundation of the lberal arts, and indeed in colleges also) has been traced to some extent to the intellectual changes instigated by the "printing revolution" by W. Ong (a mild form of the mechanization of logic, a blind alley in the history of logic as it turned out, a failed anti-Aristotelian revolution, or better, a pseudo-revolution). Binary arithmetic in Leibniz had theological resonances, and George Boole, who, it is true, was something of a triadicist, like many logicians, was in fact an enthusiast for the Holy Trinity, about which he wrote exalted poems. At the technological level, if one may draw a sharp distinction between conceptual and technological anticipations, in as much as Leibniz also invented reasonably successful arithmetic machines, Ramist logic was provoked in part perhaps by typographic resources, and if Boolean algebra of logic did not find a mechanization device for a long time it eventually proved supremely machineable, as it were, the following predecessors may be noted. The first programmed machine arose in connection with the textile industry, a branhc of production which has been called the historical laboratory of industrial economies until the early twentieth century at least, was Jacquard's loom (Proudhon saw it as of very great importance for future humane industrialism, making him almost the first cyber-libertarian, in a broad socio-political sense, albeit of a very moralistic kind, a diagnostician of "pornocracy", a word he invented one hundred almost forty years ago, but surely more applicable to our own hyper-mediatized times); the first modern cybernetic industrial machine (in the sense of being provided with a negative feedback mechanism) was Watt's steam engine with a governor (a late addition to his original steam engine, which underwent a long series of versions), thereby inaugurating the "control revolution" of modern industrial economies (though there were earlier examples of machines with negative feedback controls, but none enjoyed this kind of worldwide diffusion and range of applications); the first prototypical computer was Babbage's Difference Engine (according to one view, only the inferior quality of the materials available prevented its realization, though it may be argued that Babbage did not discriminate clearly enough between the physical and the mathematical structure of his proposed machine); the first systematic techno-economic networking, specifically of transport and communications, with great emphasis on the very term "network" (réseau), of such extraordinarily wide diffusion today, in connection with the newer technologies of information and communication, was conceived by the Saint-Simonian engineers of another technological epoch, inspired by a planetary and not merely national or simply European, vision. The word virtual (Latin *virtualis*) is attributed to Duns Scotus, and has been in the vocabulary of philosophy and natural science (mechanics, optics) for centuries. The word clone now

associated above all, perhaps with genetic engineering first gained wide currency in the English language in the vocabulary of computer technology, according to the *Oxford Dictionary of New Words* some years ago.

[3] Despite the enormous techno-hype of recent decades, the "cash-value" in macro-economic terms of the ICT developments is problematical. Between 1950 and the early 1970s productivity increased very rapidly in the US and yet from the 70s to 1995 there took place a remarkable productivity slowdown, as yet not satisfactorily explained. Only since 1995 has productivity growth resumed in the US, in a rather sudden, and suprisingly accelerated fashion (but without matching as yet the productivity growth rate of the earlier period) and it may be that, in considerable part, this reflects the delayed impact of IT and computer-controlled production (the Nobel Prize-winner economist R. Solow in *The New York Review of Books* July 3, 2003, pp. 49-51). More recently it has been claimed that the productivity pay-off of computerization computer-mediated communications and cyberneticization in general is beginning to show in American macro-economic statistics with a time-lag comparable to that of other technological revolutions in the post-war period.

[4] For Hobbes, the Leviathan was an "Artificial Person".

[5] In effect, the expression "second nature" for the world the "industrial arts" (in the widest sense) of humans shaped, is as old as Cicero, that is to say, over two thousand years old.

[6] By this term "*technoludics*" I mean the dreams, imaginative productions, putative art works involving the ostentatious use of recent technical devices or their icons, commenting on and yet dwelling in such technical devices and the technological world. Technoludics, in the main, has been a Western pursuit, in contrast to some other cyber technologies during the time of the USSR. The Pentagon's seeking counsel from Hollwywood and Disney regarding their modelling and simulations shows how serious, how deadly, a business it can be, nevertheless.

[7] The appropriation by Marx of the phrase of a forgotten French writer made it famous. Nevertheless, in addition to the role of religion (Methodism, particularly, whose role Élie Halévy emphasised) in narcotizing the masses during the Industrial Revolution, popular consumption of opiates (especially laudanum, available legally from pharmacies) was quite extensive: the opium of the people was opium, as well as religion. Iin addition, opium and other psychotropic drugs were tried by English intellectuals during this period, sometimes leading to addiction (Coleridge, De Quincey), a practice that has endured among intellectuals not least oppositional ones in Continental Europe, even during periods when mass consumption of opiates, legal or banned, was perhaps comparatively restricted.

[8] It will be recalled that was what Raymond Aron, who wrote a book with that title, called Marxism, at least among French intellectuals of the fifties and sixties.

[9] George Lakoff and Mark Johnson *Metaphors we live by*, Chicago 1980.

[10] K. Deutsch *The nerves of government* NY 1968.

[11] An overall survey of this process was published some years ago by the late Heinz Pagels, which would need to be updated in the light of the developments which have taken place since.

[12] In creative mathematics the role of "machine mathematics" (as Russian scholars called it) and especially of computer-assisted proofs is still limited: if the four-colour theorem was finally proved with computer work, the proof of Fermat's last theorem was finally done by a human, and indeed through a process which involved much collaboration with other humans, relying on recent theorems and branches of matheamtics developed by humans and humans alone, unaided by computing devices.

[13] Stalin designated writers as "engineers of the soul" (such is the standard translation of the phrase though presumably Stalin did not believe in the soul, but I suppose the point is that he once did) and anyday now similar things will be said if not about writers, about other "symbol workers" (expression of the economist R. Reich, formerly a member of the Clinton administration). In current managerialese, and it is remarkable how managerialese, as part of market-speak, has been shaping our vocabulary and even our attitudes, throughout every branch of life, cultural and educational as well as economic, "engineering" and "reengineering", in a pretty metaphorical sense, appears frequently.

[14] By "technocapitalism" is meant a stage of capitalism in which there takes place a process of ever diminshing reliance on natural resources (minerals, land, organic inputs) and labour, and an ever increasing reliance on invention and technological creativity as the motor of economic growth, exponential economic growth in which the law of increasing returns prevails over the Ricardian-style law of diminishing returns (to land, capital, technology, or other factors), as the master-key to the origination of new products, processes, and techniques of economic life in an advanced market economy (v. Luís Suarez-Villa *Invention and the rise of technocapitalism* Lanham, MD., 2000). Some economists go as far as to claim, as R. Solow famously did in a technical paper, that in principle the economy could dispense with natural resources. Others invoke a Principle of Infinite Substitutability whereby, with a few relatively minor exceptions, technology can substitute any natural, organic or inorganic input, if allowed full development.

[15] Old fashioned neo-liberalism, as exemplified by Hayek, was often suspicious of engineers, partly no doubt owing to the engineer-led Technocray movement in the US, extremely critical of conventional economics, contrasting the alleged ideal-typical outlook of engineers and their faith in what would now be called "technical fixes" for everything including the overhaul of the economy as a machine (the Technocrats believed that thy could bring about ban economy of abundance within a few years, without and even against the advice of economists or businessmen), with that of "merchants", businessmen, entrepreneurs (though poles apart in philosophy and politics, Adorno was also suspicious of the mind-set of engineers). Hayek wrote at some length in his *The counter-revolution of science*.on the engineers trained at the Ecole Polytechnique refounded by the French Revolution (and who went on to the more specialized institutions, the École de Mines, the École des Ponts et Chaussées), above all the Saint-Simonian engineers, as the carriers of three great ills of the modern age: sociology, positivism, and socialism. More recently, the historian of technology Ken Alder has addressed the formation and role of enginers in France before and during the Revolutionary and Napoleonic periods in a more comprehensive way, although "engineering the revolution" seems a far-fetched title in some ways, even if a number of engineers, engineering students and engineering professors were enthusiastic supporters of the Revolution, and accordingly engaged im war-work, and Napoleon was of course an artillery man (*Engineering the Revolution: Arms and Enlightenment in France, 1773-1815*, Princeton 1995). One may hazard the hypothesis that perhaps all revolutions or, more inclusively, all the more effervescent phases of new regimes in Europe, from the French Revolution to the 1980s, whatever the political ideologies, have provided "windows of opportunity"

for engineers, especially in terms of major projects, even in peace-time, in the satisfaction of their material and ideal interests: the Saint-Simonian engineers were the type-case of this phenomenon, possessed by a kind of missionary zeal and religious fervour (in fact many subscribed to the "New Christianity" of the later Saint-Simon), responsible for scores of important projects in a multitude of countries and in several continents, the most famous being, of course, the Suez Canal (they proposed razing one of the pyramids inherited from ancient Egypt to allow the construction of a railway, which in the event, was not a casualty of progress). The first major type of national engineering schemes were the national railway-building projects (always of major military importance although themselves constraining the pursuit of war as in the case of the Schlieffen Plan). In Portugal, the very interesting, and unintentionally revealing recent major exhibition "Engenho e obra" (held in 2003) testifies to the same trendy historiographic interests as noted in the text. The first engineering schools in Europe and the Americas were designed for training military engineers or even part of their War Colleges, and in some cases, as in France remained under the aegis of the Ministry of War/ Defence until quite recently, the École Polytechnique of Paris being a case in point: their relationship to the State was close from the beginning.

[16] P. Bentley *Digital biology*.

[17] Trained at the École des Ponts et Chaussées.

[18] The historians of ideas A. O. Lovejoy and George Boas discriminated sixty-six senses of "nature" in their great historical survey over fifty years ago, which included classical as well as medieval and modern European writers (some of these senses would be correlated with various senses of "artificial"). Kroeber and Kluchkohn in the 1950s elicited some one hunded and fifty senses of the word "culture" (some of which would also be correlated with various senses of the artificial). But I know of no comprehensive survey of the historical semantics of the noun/adjective "artificial", which would have to encompass writings on the arts, the liberal, mechanical or fine arts, on aesthetics, as well on technology and philosophy, but it seems plausible to conjecture, given these two precedents, that several scores of senses might well be elicited if such a survey were caried out. In the references in the text it is clear that any pejorative charge that might have accrued to some of the earlier usages has vanished. Similarly the varied senses of "virtual" (a word of Latin origin) in the history of Western thought and in today's usages in physics and other fields of science and technology, deserve a proper analytical survey. Even Marx after all, drawing a parallel with D'Alembert's mechanics where he treated "virtual velocities", wrote of "virtual capital" (in a posthumously published part of Capital).The very helpful, and widely consulted, handbook by Raymond Williams *Keywords - a vocabulary of culture and society* (London 1983) has a useful entry on "Nature", whose very first sentence states that this term "is perhaps the most complex word in the [English] language", but even the second edition, dating from 1983, lacks entries on "artificial", "virtual (reality)", "information" or any "cyber-" term, and indeed on any of the most important words in the informational constellation, nor do they appear significantly within the existing entries. This may be due, in part, to the "two cultures" gap, that his Cambridge colleague famously diagnosed, but mostly, I suppose, due to culture lag, or the rapid acceleration of techno-economci change since the late 1970s: still, it is surprising that these things had not yet impinged so seriously on the social consciouness of the country, and not even on the perceptions of a Marxist and cultural materialist as to present themselves as irrecusable topics for such a lexicon of contemporary culture.

[19] A philosophically-minded British professor of electrical engineering, Reginald O. Kapp, wrote in 1940: "biologists have not learnt to distinguish between what the physicist observes and what he invents, nor to realize how much of his experimental material has been invented by himself and manufactured by human effort to his specifications.The physicist investigates, let us say, pure copper. But pure copper is not found in Nature. Only copper ores are found and these have totally different properties. Pure copper is a material which needs a specification. And it is a specification which Nature does not follow. The bottles on the shelves of a chemical laboratory contain substances which someone has specified and someone has manufactured and which nature does not produce. The text-book atom is but another example of one of the things which meets a specification devised by the physicist, not by Nature. /But the biologist hardly realizes this because his own methods are so different. He does, for the greater part of his time, investigate and describe what he has found and not he has invented. His observational material is manufactured for him by Nature" (R.O. Kapp, *Science versus materialism*, London, 1940, p. 71). Since then, as we all know, things have changed drastically as far as much biology is concerned, the biologists have learnt their lesson only too well, their physics envy being much mitigated. Indeed molecular biologists have embraced physics by designating molecular genetics as the means whereby biology, will be reduced, in principle at any rate, in one or another sense of "reduction", to physics or physics-chemistry, to macromolecular physics most immediately. The kinds of reductions (normally understood as micro-reductions) of one science to another, or one branch of science to another, that may be accomplished or aimed at (even if not successful) in the life sciences are various, and five different kinds at least have been discriminated in the literature (Sahotra Sarkar *Genetics and reductionism*, Cambridge 1998).

[20] M. Minsky on the brain as "meatware".

[21] The famous terms of Lévi-Strauss.

[22] Hayek drew a classical distinction between "prediction in detail" and "prediction in principle". This is somewhat analogous to that drawn by Hempel between "explanation sketches" and "full explanations" of the deductive-nomological kind, though in the latter case it seems a continuum was involved rather a dichotomy, and Hayek would not have susbcribed to the Hempelian teaching of the logical symmetry of scientific explanation and scientific prediction (and of prediction and retrodiction), which implies that if you can explain you can predict, and vice-versa, and in equal measure, though often scientific explanations are forthcoming without comparable predictive power, as in Darwinian accounts of evolution, or you can predict without the proper explanations (at any rate of a deductive-nomological kind) to warrant the predictions, as in "black box" types of prediction (for a congruent claim see the reference to S. Wolfram; domains where determinstic chaos matters are cases in point, inasmuch as, being deterministic, they yet afford low predictability). A "prediction in principle" merely outlines the over-all pattern of key phenomena to be expected from a given policy or "exogenous shock", without the kind of quantitative specification of the results of policies or the impact of events, which are very often possible in the physical sciences, and which has been aimed at, so far with only modest success, by econometrics. Hayek, of course like, other "Austrians" (and in this point, if nothing else, converging with Keynes) was very critical of the aims and ambitions of econometrics.Though genetics in recent

years has ranked its predictive powers rather high, in fact, a behavioural trait, strictly speaking, should be called genetic if and only if genes, and genes alone, provide the best explanation for it, whereas it is the case that most complex behavioral traits in the case of human beings cannot be accounted for in this stringent fashion (S. Sarkar, *op.cit.*). But then, where genetics is, there loose talk for public consumption abounds. Curiously, although a standard formula, indeed a kind of mantra, of positivist philosophy of science was always that science ains at "prediction and control", one rarely finds in textbooks of the philosophy of science much explication of "control", or much systematic discussion of control as a critical issue in the philosophy of science, and the relationship between control and prediction (except in minor senses like "controlled experiment", or "statistical controls").

[23] Ray Kurzweil, one of the the most important of cyberprophets today, has commented at some length on the Wolfram project.

[24] The reference is to Francis Bacon, the "prophet of industrial science" and author of doctrines of scientific method which have been highly controversial, condemned by the Popperians as crass inductivism, but pretty thoroughly rehabilitated in some post-Popperian quarters and elsewhere, as we can see from the very name given to these inductive reasoning programs

[25] Popper used to begin his lectures to undergraduates on scientific method at LSE (which I attended) by emphasising that scientific method or methods are not at all like sausage machines (sensory input, cognitive output). The methodological, "intelligent" sausage machines have arrived, at least in metascience simulation, in the rational reconstruction ex post of the production of knowledge. And the tacit expectation that we can rely on one kind or another of algorithmic procedure as the functional equivalent of that sausage machine dies hard.

[26] Ross D. King and seven other authors "Functional genomic hypothesis generation and experimentation by a robot scientist", *Nature* 15 January 2004, pp.247-252.

[27] Cf. my paper "The marketisation of the universities " *Metacrítica* no. 3, 2003.

[28] I understand that courses on the philosophy of technology used to be taught in many Schools of Engineering in the USA: on the whole, it does seem to have been a waste of time.

[29] Ruddy Rucker *Mind tools – the mathematics of information* London 1987.

[30] Jeffrey Satinover *The quantum brain- the search for freedom and the next generation of man*, New York, 2001, p. 137 and p. 111. The notion of "ontological metaphor" was advanced by the linguist George Lakoff in collaboration with the philosopher Mark Johnson in their Metaphors we live by, Chicago 1980.

[31] The notions of "floods of information" threatening to "engulf" or "swamp" us, of a "sea of information" surrounding us, of the need to "navigate", or "surf", or "swim" in the "sea" or "ocean" of information, and indeed the very etymology of the word "cybernetics" (*cybernetes*), of steering a ship, or the helmsman, warrants these images, have accompanied the ascent of the informational galaxy from 1945 more or less, Some appeared originally in the context of the first cybernetics of Wiener et al., through the Cold War when these metaphors became politicized and even militiarized, and went on to redeployment in the widely read science fiction of William Gibson which has also been much filmed (Mark D. Bowles "Liquifying information: controlling the flood in the Cold War and beyond" in Miriam R. Levin "*Cultures of control*" Amsterdam 2000).

[32] We are not going to engage in this paper with this influential account of matter-theory. Many others have done so.

[33] An outlook shared by Leibniz and Spinoza, and perhaps Locke as well.

[34] There is a very useful collection of the classic papers in this field under the title *Maxwell's demon*.

[35] There is a technical question here which may be adverted briefly. Kant contradistinguished the forms of sensibility ie space and time, from the categories of the understanding (causality, finality, substance, etc.). Renouvier regarded this distinction as untenable, as indeed he regarde the trichotomy of sensibility-understanding-reason and the notion of the noumenon associated with this trichotomy as a colossal error and the key source of the great metaphysical explosion of systems of Absolute Idealism that ensued. Hence his categories of thought included the Kantian forms of sense-intuition, space and time, as well as the Kantian categories of the understanding proper.

[36] Like "ideology" (a wide category) for Althusser, and perhaps for Marx.

[37] Here "Collingwood" may stand for a whole array of propounders of similar theses, most of them far better known, but not necessarily superior in the appeal of their visions, the cogency of their arguments or the lucidity of their expositions (a discussion of these theses, complementing the present paper, will be published elsewhere) .

[38] N. Rescher, *Essays in philosophical analysis and Nature and understanding* NY 2001. The legitimacy, historic role, and indeed the very existence, of evaluative metaphysics, should be more widely appreciated. Failure to do so is a source of many misunderstandings concerning the scope of metaphysical inquiry and reflection. It is to be hoped that enlightenment on these matters may proceed.

[39] Paul Churchland is a leading exponent of this perspective.

[40] In Davidson's "token identity" theory, mental states and brain states are deemed to be identical, and yet, becausew they are only token-identical (particular to particular), the "anomalousness of the mental" obtains, and thus no laws which could enable us to predict mental states from brain states in the Hempelian fashion (hence the locution "anomalous monism" to designate his position). This is one of the most widely referred positions in contemporary philosophy of mind. If the sociocultural supervenes on the psychological in an analogous fashion, we could identify social facs with states of minds, without thereby commiiting ourselves to the claim that there are bridge laws that would enable us to predict nomologically social states of affairs from knowledge of the minds of individuals.

[41] A spirited contemporary defender of "emergent materialism" (which could also be called "emergent mentalism", for, according to this view, mental life emerges from organic life, but is not reducible to it without remainder, and has its own laws) is the prolific exponent of "exact philosophy" (using the tools of logic and mathematics to secure precision in philosophy, as well as reliance on substantive scientific findings), Mario Bunge, a former physicist. Of course there are other forms of purportedly nonreductive philosophical/scientific materialism in connection with "supervenience" theses, widely discussed in the last decade or so.

[42] D. H. Reuben *The metaphysics of the social world*, Byron Kaldis Holism, *language and persons*. J. Margolis defends a form of generalized emergent materialism, in that culture itsef is designated as an emergent level of reality, not reducible to individual psychology (psychologism) or the actions of individuals.

[43] A very interesting statement of "relational realism" appears in H. Alpert's 1939 book on Durkheim in his explication and purification of Durkheim´s social holism.

[44] Renouvier was the first and remained almost alone, save for his disciples like the dialectical idealist Hamelin, in including the category of the person in his table of categories (which started with the category of relation and culminated in the category of the person). Durkheim followed him in this "categorialization" of the person, and Mauss eventually published a rather schematic paper on the category of the person (the subject of a collection of anthropological papers some years ago). In more recent philosophy, Nicolai Hartmann, who wrote extensively on category theory, included "personality" as a category of the realm of "spiritual being".

[45] Scientists like E. O. Wilson sometimes write of "the mythology of scientific materialism", not to dissociate themselves from its truth (or its purport as the whole truth, and the only truth), as might be naively thought, but not to scare us too much.

[46] "Stripping away the veils" was a metaphor for this final disclosure of underlying ugly reality, used for many decades by and about major thinkers, like Marx and Freud, and other important or very infleuential scholars well into the twentieth century, but now seems to have faded away. Perhaps Virtual Reality has struck the final blow against this particular metaphor.

[47] There is a classic paper by the sociologist Peter Berger on the obsolescence of the concept of honour in contemporary Western societies (some have claimed that shame is going too), leaving open the possibility that we might still legitimately claim dignity and demand to be treated accordingly. These movements of thought proclaim the obsolescence of the concept of dignity (B. Skinner Beyond freedom and dignity). They may be right, although somehow we cling to it, as the last claim of the defeated, the conquered.

[48] The often been castigated as sexist, masculinist, androcentric, patriarchal, phallocratic in ideological motivation or affinity. However, the founder of behaviourism, John B. Watson, curiously referred to psychology according to the feminine gender, unusual at the time, and even now. With Haraway we now have a clear-cut version of machine feminism, and thus at least one version of the machine theory of humans, more specifically of mechanizing humans into the post-human era, is, therefore, OK: no problem!

[49] Trivially, it is true of course that many of us would qualify to some extent for incipient cyborg status by virtue of a great variety of temporary exosomatic or in-body (but externally produced and maintained) prostheses such as glasses, hearing aids, artificial limbs, false teeth, pacemakers, breast or penile implants, etc. Microchips of the sort that is meant to control the nervous system and brain function and to couple the person to other microelectronic external devices, or microchipped human or non-human beings, would seem to place us on a higher level of cyborgification (though domestic pets are increasingly microchipped instead of conventionally tagged, especially for cross-national travel within the EU, or for humbler purposes). None of this qualifies us in any substantial degree, as yet, for the mission for which cyborgs were originally designed, space travel, space migration and extra-terrestrial residence. On the other hand, a number of animal-obsessed people in the US and some other Western countries have gone and are going now to extreme lengths, undergoing repeated operations, sometimes painful, and dangerous surgery and other procedures, to accomplish "extreme body modification", often quite extensive, spending good money in the process, not for therapeutic or religious reasons, but in order to become more obviously animal-like, at least phenotypically, resembling in important features some animal species or other (more like leopards, or cats, or even serpent-like by forking their tongues, etc.). The pull of the living animals, of zoomorphy, to the extent of reshaping our bodies to mimic them, is generally regarded as aberrant, or even disgusting (some of these procedures, it is true, can be justified in terms of greater human satisfactions, especially sexual ones, but this kind of instrumental, straightforwardly hedonic justification does not appear to be the prevalent one, and certainly not the exclusive one, among human zoomorphs). At any rate, these people appear to ignore the call of cyborgification and go the other way so to speak. Yet the pull of the mechanical, the lure of becoming more like machines, of becoming cyborgified or robotized, is seen as a higher calling than zoomorphy, if indeed not our highest calling, our post-zoological, post-biological, mechanical post-human destiny. The favoured imperative or hortative is clearly "become cyborgs"! Those who feel misgivings about this injunction can then be told "we are already cyborgs anyway, so what's the problem?" The most obdurate will be told "alright, if you insist, we will concede, for the sake of argument, that we are not all cyborgs yet, in every way, or it may not show very much yet, but we will all become cyborgs anyway, sooner than you think, no matter what you do or feel: my advice is, as the saying goes, if you can't beat them, join them!". These three moves exemplify a very general pattern of argumentation in all forms of technophiliac discourse, a typical schema of techno-persuasion.

[50] John Dewey *Experience and Nature* N.Y., 1929, p. 301.

[51] No prizes for guessing that the allusion is to Donna Haraway as siren singer nonpareil in these matters.

[52] Bruce Mazlish. Regarding the Copernican revolution, in some ways the new astronomy improved things for man, for the central place in the Aristotelian-Ptolemaic universe was by no means seen as a wholly positive, but also as a negative privilege, being especially corrupt: turned into an ordinary place like any other, with nothing special about it, no special spatial location, the abode of human beings, the theatre of the salvation story lost this awfulness, though it may have gained other disabilities, like cosmic insignificance in non-religious respects.

[53] It is widely asserted that no science (outside mathematics and physics) which fails to claim Darwin as a supreme inspiration can be taken very seriously. At any rate, there have been recent further attempts to re-Darwinize sociology from within (something which has been tried again and again "ever since Darwin", without yielding a substantial corpus of cumulative knowledge), as yet with little impact on this very, very conservative discipline (which is not to say that some proposed or realized extensions of Darwinism, sociobiology or evolutionary psychology to the social sciences are particularly helpful).

[54] A helpful analysis by Rescher on this score

[55] Timothy Shanahan *The evolution of Darwinism –Selection, adaptation,and progress in evolutionary biology* Cambridge 2004.

[56] David Bohm, in his treatise of quantum mechanics written before he became a Bohmian, so to speak, dissenting from the orthodoxy and becoming a major if not indeed the major gadfly in the field for many years, has a passage of great interest in this context: "in many ways, the concept of a virtual transition [in quantum theory], resembles the idea of evolution in biology, where all kinds of species can appear as a result of mutations, but only certain species can survive indefinitely, namely, those satisfying certain requirements for survival in the specific environment surrounding the species" (*Quantum theory*, London, 1951, p. 414). "Virtual transitions" are of course prodigiously numerous in the microworld, perhaps by virtue of a kind of a "principle of superfecundity", comparable to that

borrowed by Darwin and Wallace from Malthus, but only some are entities have staying power to be realized in actuality. The Darwin-Wallace-Malthus schema thus appears as an "ordinally neutral" principle that holds good of every level of reality, from the deepest to the most inclusive, from the microworld to the entire cosmos. Of course, if biological mutations are due to quantum effects there are substantive, causal links as well as formal analogies between the quantum realm and the realm of biospecies evolution. The formal analogies would warrant the expression "ordinally neutral law" (the term "ordinally neutral" is due to C. D. Broad in his *The mind and its place in nature* devised to apply to laws or mechanisms that operate isomorphically at different, "emergent", levels of reality). It is intriguing that some physicists have even written of "selectors" in their discussions of the perplexities generated in quantum theory (E. Squires). A Darwinian-informationalist view of the microphysical world has not yet appeared in very explicit fashion, at any rate as put forward by physicists, though there are hints elsewhere, and it would not be too difficult to draw ou of recent writings: if matter at the quantum level is information and if, as Bohm suggested, a kind of Darwinian schema is applicable to the quantum world, the conjunction of these threses wold yield a Darwinian-informationalist picture.

[57] *An essay on civil society* (1762).

[58] "*Goodbye body*" (manuscript in the possession of the author).

[59] On biosemiosis the writings of Jasper Hoffmeyer are particularly illuminating.

[60] The biologist T. H. Huxley, "Darwin's bulldog", professed the "automata theory" (as he called it) of the mind, and indeed defended epiphenomenalism (the view that mental events have causes, but have no effects, either with respect to other mental events or to any non-mental ones, a very widespread view in the second half of the nineteenth century), with brio: we are automata, as the Cartesians claimed non-human animals were, and that's that. But I don't recall that he linked this stance to his Darwinian evolutionist convictions, though presumably he believed at least that they were mutually consistent, and even, possibly, mutually supporting. "Automata Darwinism" , the conjunction of the automata theory regarding organisms and biological Darwinism, is today *de rigueur*, reinforced by the extreme geneticization of the organism, and the computational theory of mind, though it is not clear that Darwinism entails the automata theory regarding organisms, and surely the automata theory of organisms in general, and of animals in particular, does not entail Darwinism (a theological version of animals as full-fledged natural automata flourished before, in Cartesian thought through Malebranche and after, just as the mechanical natural philosophy of Boyle was theologically inspired).

[61] The Greek term "*automaton*", incorporated the word "*mat*" which is an Indo-European root, which appears in such words as *mens, mind, mente* (respectively Latin, English, Portuguese) and their cognates. Automata are referred to in the *Iliad*.

[62] Strawson's expression.I call "para-anthropology": the study of such artificial cybernetic beings devised in similar fashion (robots) which are purposely designed to operate below the human level of intelligence, though perhaps the equal of humans ("*workalikes*"), or surpassing, humans in specific motor or other functions (but not necessarily "*lookalikes*", i.e., looking like us, with or without extreme body modification). This class has many actual members, abandoned or scrapped as well as operational, and indeed a large and increasing population. Such robots (not necessarily humanoid in appearance) have been designed, or are being designed, to act as helpers, paramedics, warriors, aviators, workers, even "maids" ("maids"? - Donna Haraway, where are you when we need you?). The Republic of Korea is making considerable investments on the development of military robots to replace, as much as to supplement, human soldiers, as doubtless the US is too, in the drive towards the ever more intelligent batlefield and the ever more informatized, casualty-minimizing, sure-win war over any enemy. The reference to "maids" is not made up: it appears in the work Robo sapiens. I have already referred to Artificial Ethology which could also be called Artificial, or Robotic, Zoology, the design of animal-simulating (functionally, if not necessarily morphologically or phenotypically), robots.

[64] Accessible through the Internet.

[65] In work done by the neurologist James Olds three decades ago. Rats that got addicted to pleasure centre stimulation died through failure to meet other life-needs, like food or water-intake, after short lives of pure bliss, such as probably no animal had ever experienced in the whole history of the realm before neuroscience came along (others managed not to get addicted, and took their exceptionally intense pleasures with moderation). I cannot imagine that a sophisticated, updated, larger-scale version of these experiments in fatal bliss addiction will not be tried out someday, whether on rats or on other "living automata" (on some species or population or other). Perhaps not by humans on animals or other humans or even themselves ("pleasure machines" to the highest degree). But conceivably it might be tried out by the Super-Intelligences which many trans-humanists expect and indeed fervently hope will arrive, at the current rate of advance in Artificial Intelligence and allied fields, some time between the years 2020 and 2050, for whom perhaps the most immediate target species may well be homo sapiens sapiens (not the worst way to go, perhaps, as forms of *species-euthanasia*, of species-wide mercy killing, go: most species-extinctions, including hominid ones, have been brought about in unrelieved terror, agony, desolation). After all, trans-humanists refer to the passage to Super-intelligences as the "Rapture". Perhaps something like this has already been depicted in some movie or other.

[66] You can look up the topic, or at least the phrase, in the Internet.

[67] It is curious that all the sentences that Lakoff and Johnson in their book on metaphors, published in 1980, list to illustrate the theme "the mind is a machine" bear the imprint of the Steam Machine Age (such as "running out of steam") or the Automobile Age ("the wheels are turning now", "I am a little rusty today"). If they were writing today presumably they would have added conversational locutions of the Computer Age to illustrate the current folk-embedding of the master-metaphor of "the mind is (like a) machine", such as "give more input", "being hard-wired for", "data base", "reboot", "run a new program", etc. Their general characterization of seven marks present in all such instances of the mind-as-machine topos is still rather instructive : "a conception of the mind as having an on-off state, a level of efficiency, a productive capacity, an internal mechanism, a source of energy, and an operating condition" (p. 28). The "on-off state" is even more salient with our utter reliance on binary digits, though one learnt this as much from the taken-for-grantedness of ubiquitous on-off electric switches as from anything else, though ordinary acess to electricity supply need not have assumed this almost universal digital character (there were analog devices). In a later work, published in 1987, Lakoff addressed at some length the computational theory/metaphor of mind.To be sure, in ordinary language we also use other metaphors for mind such as "the mind as a britle object", which is surprisingly common,

as they note. That is to say, it would seem licit to hypothesize that in the West, in our commonsensical mind-talk, we are not generally possessed by a single master metaphor for the mind, but resort to a variety of machine metaphors without commitment to or even perhaps belief in any kind in particular (metaphors can surely be deployed in a non-doxastic mode), as we dwell in the "paramount reality of everyday life" (Schutz).

[68] One swallow does not make a summer, but the fact that an American sociologist has felt it necessary to write a book, even qua sociologist, in which the concerns of philosophical anthropology are paramount, and get it published by Oxford University Press, is definitely a good sign.

[69] Someone once objected to an ancestral version of this paper in one short, sharp sentence; "We are all copies!" .The context was my discussion of the obsession with the Perfect Copy, which obviously irritated this member of the audience. I was reminded of an English poet's verses, written, it should be noted, in the eighteenth century: "How come that we are all born originals/ and yet we all become copies?"(Edward Young "*Night thoughts*"). With human reproductive cloning it might become true that many of us would not become copies, but would be born copies, by design, not by accident. Perhaps never quite perfect copies, as suggested by the Fordist model in Huxley's dystopia, but it is till curious that in an age that boasts of having left Fordism behind in industrial production and turned to a variety of Post-Fordist models of production and work organization, we are going into reproductive Fordism as the dernier cri of the newer reproductive technologies. The raw material of Evolution in the world of (natrual) life-forms has been precisely inter-individual differences, as revealed in phenotypes.Without inter-individual differences, maximized through sexual reproduction, no evolution, as we have known it. Evolutionary biologists have taught us about the key role of sexual reproduction in speeding-up evolution but now asexual reproduction, cloning, is on the agenda, but it it is not clear that biologits have in mind now, perhaps as a kindness, the deceleration of evolution as a a goal. Still, I am sure the speaker did not have in mind the Timaic cosmology in which everything is a copy of a timeless, logically and ontologically prior model.

[70] I have written on these matters of the dreams and projects of the ascent of "spiritual machines" in "Aceleração, tecnogénese e experimentum humanum" in the book I edited with José Luís Garcia and the colaboration of Helena Jeónimo *Dilemas da civilização tecnológica*, Lisboa, Imprensa das Ciências Sociais, 2003, pp. 19-77, and in "Tecnociência e arte" in Carlos Leone (ed.) *Rumo ao cibermundo,* Oeiras, Celta 2000.