

INFORMATION AGE EDUCATION IN A SUSTAINABLE WORLD

© Thomas Vietorisz
(Cornell University)

tv12@Cornell.edu

© László Z. Karvalics
(Szeged University)

zkl@itm.bme.hu

Heading off the fast approaching global ecological and social crisis, the education must necessarily play a crucial role. What is essential is the kind of education that involves newly emerging generations of society, both cognitively and emotionally, in the creation of new knowledge about increasing ecological and social risks and their remedies. The transition to sustainable development crosses the integration of education with science in a vision of "knowledge producing megamachines of the future" - the hybrid communities of scientists, teachers and students.

Keywords: Paulo Freire, science, education, information society, control, sustainability

The core idea of Paulo Freire's life work sets out the right kind of education as the master tool for liberation from oppression and for movement into constructive human and ecological relations of development. This core idea, as valid to-day as at the end of Freire's life ten years ago in 1997, points toward major updates, or perhaps rather implications, of Freire's ideas for our contemporary world.

We wish to explore in this paper two such implications which address crucial problems of our day. Though seemingly quite distinct, they turn out to be closely interrelated. One, which we will address first, is the need for establishing a seamless fit between (i) the practices of day-to-day education in the schools and (ii) science as the extension of knowledge in our rapidly emerging information and knowledge society. This is essential for making either education or science function effectively in such a society. We shall see that achieving this goal successfully and comprehensively presupposes a broad reorganization of our social communication and control processes, while at the same time the integration of education with science itself contributes an important, but by itself probably insufficient push toward advancing such a broad reorganization.

The other implication of Freire's core idea, which we will take up subsequently, pertains to the transition to sustainable development. Such a transition, aimed at heading off the fast approaching global ecological and social crisis, requires a profound culture change in which education must necessarily play a crucial role. Indeed, what is essential is the kind of

education that involves newly emerging generations of society, both cognitively and emotionally, in the creation of new knowledge about increasing ecological and social risks and their remedies. This applies particularly to the fine detail that is of most concern for improved ecological and social functioning of more cooperative communities at regional or local levels.

Thus the liberating education advocated by Freire, integrated with the functioning of science, offers one of the most powerful tools for bringing about the difficult culture change demanded by the transition to sustainable development. Overcoming the resistances to such a culture change, and confronting its sacrifices, is in turn ever more strongly motivated by the threat of the approaching crisis. As the profound and broad culture change takes hold, a gradual reorganization of social communication and control processes becomes its necessary part, and this in turn creates an increasingly encouraging social environment for the closer integration of day-to-day education with the creative scientific effort.

Twilight of "banking education" and the perspective of creative scientific effort in the practice of the schools

Dialogue is our starting point. In Paul Freire's words: "*Only dialogue, which requires critical thinking, is also capable of generating critical thinking. Without dialogue there is no communication, and without communication there can be no true education.*" We thus begin by addressing the perspective of moving toward an increasingly productive fit between day-to-day education in the schools and the creative efforts of science in our rapidly emerging information-and-knowledge society.

In relating the present state and dynamics of science to education, we draw on the seminal model of James Beniger which allows us to characterize the current situation and dynamics of science with great descriptive power as a *control crisis*. Such a crisis is relatively milder in fields where it is possible to continue with the mechanization of brain-work capable of being translated into algorithms, that is, with the computerization of intellectual effort. Yet the scientific community is step by step moving toward the recognition that the bottleneck is in the area of insights that cannot be represented by algorithms; the process of knowledge production is constrained by human brains capable of interpreting, placing in context, and thereby counterbalancing the sheer mass of raw information being generated.

The new control revolution of science can therefore emerge only from the human infrastructure, can only be a revolution of human relations, and as such calls no longer for technological but rather for social innovation. Public education is a human *mega-machine* - using the metaphor of Lewis Mumford - that is already at hand. It appears perfectly suitable, while radically renewing its current functioning, for becoming such a mega-machine for research too, thereby solving science's control crisis and incidentally also that of its own. In the year 2007 there are approximately 800 million students in the 12-18 age cohort, supervised in an orderly and structured manner by some 40 million teachers, according to a rough but conservative extrapolation based on UNESCO data for the year 2004. The organization of this giant social mega-machine of the future emerges as a *hybrid* of scientific researchers, teachers, and students which is multiply articulated in depth and in which assignments are distinguished as a function of the time requirement, the profundity, and the scale of each task.

Students and teachers have already for some time been active participants in real-life problem-solving scientific projects - in relatively small groups and by happenstance. From this point on, it requires only a powerful step for *all* students to become parts of the mega-machine and to interpret, beside many other things, astronomy-produced images, become problem managers looking for personal insights about individual archaeological objects, cooperatively identify possible pharmaceuticals, discover meaningful micro-patterns in genomes billions of bases long, or cut original paths through the jungle of environmental information produced by supercomputers.

This is a seemingly utopian but in fact highly realistic world, because the process of overcoming the control crisis of science opens up the possibility for bringing about a pragmatic shift in public education, for which leading voices in the field of pedagogy have long been ready in principle and in theory. In a nutshell, this is a vision whose pedagogical and sociopolitical content has virtually grown out of Freire's overcoat. His emblematic book published in 1970, *Pedagogy of the Oppressed*, has set out in a normative manner the direction in which the schools and the process of instruction had to change in order to cease serving *oppression* and turn into agents of *liberation*.

Freire arranges the basic characteristics of the existing systems of instruction around the category of *banking education*. The teacher teaches and educates; the students are being taught and educated. The teacher knows everything, the student knows nothing. The teacher talks, the student listens and follows the choices and thoughts of the teacher, the specific items of *contents* specified by the teacher. The teacher acts, the student gets to follow the teacher's activities and thereby obtains the illusion of acting. The teacher conflates his personal authority in his specialty with the authority of knowledge, degrading the student to being the *object* in the process of learning. Accordingly, all that banking education accomplishes is diminishing or actually wiping out the creative power of the students, in the service of interests that oppose changing the world. For that reason there is also strong pressure for the distancing of the contents of instruction from reality, in order to avoid any increase of a critical sense or of a recognition of interconnections possibly attached to the latter - filling the consequent void with the false practice of humanitarianism. The oppression is mechanically faceless; Freire uses the term *necrophilic* to designate the *overwhelming control* that rests on memory instead of practice, that values *possessing* knowledge higher than *living it*, and instead of life's fullness transmits only its shadow. The culture and the knowledge that are preserved in this system as the goal of the student's cognitive efforts are in reality more the *knowledge property* of the teacher, and for want of reflection and a role in their transmission by the student represent no real knowledge and no real culture.

During the decades since the publication of Freire's diagnosis, the culture of pedagogy in all parts of the world has moved away significantly from the extremes of banking education, while the mainstream of teacher-education culture has addressed modernization in the same spirit. Under the umbrella of pedagogical constructivism a practical and successful countermovement has emerged which has stepwise transformed more and more necrophilic characteristics in the schools, whether these be located in a district of Chicago, Malmö, Budapest, Valparaiso, Manila, or Maputo, and with the emergence of the internet this process has indeed spectacularly accelerated. In to-day's education theory and political philosophy there is no significant force that would want to reverse these processes rather than advance them.

And yet, the ongoing real changes are *not at the system level and do not reflect the system's characteristics*. They occur by *happenstance*, meaning that the choices of persons, of educational decisionmaking bodies, or educational policy movements determine whether something is done, or nothing is done, in the interest of transforming the methodological culture, the dominant perceptions, or the hidden instruction plan of pedagogy. The changes are *sporadic*, in that they possess *no uniformity or pervasiveness*. They are *uncertain*, because up-to-date standards do not form or solidify on the basis of deeply ingrained patterns, along largely identical paths of advance, but are exposed until the present day to the choices of teachers, teaching styles, principals, and educational bodies. They are *parochial*, because coordination cannot move into the broader planning space beyond the limits of nation states, owing to narrow community-based financing and an excessive representation of national cultures at the level of schools. They are *hypocritical*, because the apology of "small steps" is molded into an argument precisely for the sake of avoiding genuine challenges, and the disarming phrase, "the system has already changed in many places," is a cover-up for, "in even more places it has changed not at all."

As a therapy, Freire in 1970 proposed that the pseudo-participation of the present, the illusion of participation, should be replaced by *co-intentional education*. The place of the *student*, defined as the Object of the activity of education, has to be taken by the student emancipated as an Actor, together with the teacher, so that the two may jointly act to discover and recreate again and again the knowledge that is linked to reality by a thousand threads. Jointly contemplated units of knowledge of a strongly pragmatic character, addressed by means of joint reflections and critiques, shape the processes for which not an outside compulsion but internal commitment is the driving force - the first step on the road to liberation. Knowledge can only be action-centered; what good is knowledge that we do not intend to use for changing the world in some way? What good, if it is not some challengingly live problem that organizes the process of learning, in order to wrap itself into it?

Freire's solution is centered on dialogue which is essential for communication, and also on critical thinking, indispensable for the capacity to cooperate. The revolution will come to a head when the acquisition of knowledge is no longer forced into a straight jacket sewn together from pre-programmed subject-material strips, under the stormy skies of a methodologically shoddy culture of rewards and punishments. It will come when *individuals armed with a capability for dialogue and critical thinking reflect and re-present their own personalities in the framework of a cognitive process chosen, organized, systematized, and developed by themselves*.

But do the old, necrophilic structures still weigh down education and continue to oppress coming generations? Or can we already perceive the outlines of the ongoing paradigm change, reflecting a radically new spirit in the transformation of the student, the teacher, the process of schooling, or the material of instruction?

We must answer the last question quite definitely in the negative. Although the first shoots of a very differently oriented knowledge management and instruction philosophy have sprung up here and there, although it is true that the oppression is softening, that things are "better" than before, *this does not mean that a genuine emancipation has occurred*. The mass production of knowledge is continuing, in the sense that the objective function of the respective efforts is the change of knowledge in the student's head, together with a measurable output of knowledge which the student is capable of regurgitating. The process is still the transmission of the bodies of knowledge distilled into instructional material - portion by portion,

with a spoon, with a cook, predigested. Even the most modern schools are still pervaded by the stale air of the labor-market requirements and national-identity attributes of the last third of the Nineteenth Century.

Freire's twin star, Ivan Illich, sets out the root cause of the above panorama in his similarly provocative book, *Deschooling Society*, also published in 1970. Illich identifies this as the *merger of world bureaucracies which homogenizes not only the schools but also economic life, commerce, the system of political institutions, public health - and let us add, science.*

We know from James Beniger that all this is the result of a "control revolution" that started in the last third of the Nineteenth Century and had a determining importance on the first third of the Twentieth Century. This control revolution represents the triumph of technological and social innovations which support the capability of providing guidance for production and distribution (and thus for the economy and politics).

The core concept of the schools has also been shaped from the very beginning by this bureaucratic control. Three cardinal elements of this concept - financing, definition of the plan of instruction, and teacher education - remain in their essentials basically unchanged to the present day, even if they are to some extent colored by alternative school support institutions (self-governing political units, foundations, churches) or alternative instruction materials. Everything else is erected on top of this base: materials of instruction, maintenance of discipline, regulation of functioning, hours of instruction, and the specialized as well as pedagogical content of the latter.

Differences among the schools can be characterized in terms of the superstructural aspects, or else in terms of the differences in the performance, level of excellence, and preparation of the teachers who have a decisive influence on the quality of instruction. Every reform that served to update the superstructure with the renewal of the techniques or subjects of instruction, of the methodological culture, or the time schedule and work organization of the schools, has improved the overall performance while leaving unchanged the structural determinations of bureaucratic control.

The discussions that have started up about the "worldwide crisis of education" have also largely revolved around the functioning of the superstructure. They have failed to draw attention to how the schools have continued, all the way to the present, to perform in a perfectly effective way their functions that had evolved during the industrial era: supervision of children during their parents' work time, production of literate generations capable of working together in handling the mass of tasks of production and administration, securing the steady replacement of teacher supply, and early tasks in the education of a scientific elite.

Yet, in the schools under the bureaucratic control of the industrial age the child is secondary; the most important objective function is a measurable performance in terms of knowledge and the development of the inclinations and capabilities necessary for citizen interaction and the internalization of culture (consumption). The school of bureaucratic control does, in its own clearly understood self-interest, "permit" intelligent, committed pedagogues with a heart of gold to fill the lives of children with sunshine - provided that these pedagogues are in the mood and have the time and initiative to do so. Yet this same school does not care if its rooms are turned into prisons by the emotional terror and alienating boredom of indifferent, counterselected, unprepared, and undermotivated teachers.

Gaudig, Freinet, Freire, and many others during the industrial age have already dreamed about the school of the knowledge society. Illich has, however, correctly perceived that for the creation of a world oriented to the

new conceptual image of the child and of the human being, the first task is to change not the schools but the economic and political order standing behind them; then the schools will also change. In other words, to address oneself to the problems of the schools without making sure that the bureaucratic control defining the conditions of their existence is replaced by something different, is in the words of Illich a "construction of bridges to nowhere."

Yet, a revolutionary enthusiasm for direct action does not take sufficient account of the inherently favorable circumstance that a control crisis, even in the absence of radical social renewal programs, unfailingly delivers the future. What we have seen in the past decade is that although bureaucratic control has successfully utilized precisely the systematic application of many wonderful new achievements of information technology for lengthening the path and the time that lead to the unfolding of its own crisis, these are only holding actions. In the midst of all this our attention is drawn to ever more system-level developments that *already point to the new type of control environment of a subsequent era* - without deliberate intervention, propelled by the logic of change of current conditions.

As examples, we wish to mention four phenomena that present different sides of the same structural transformation.

1. The Internet, while offering many-sided support for traditional market solutions, has in part also created interesting alternatives to the former. With the Internet's maturation it has become suddenly clear that the social output of individuals and groups that organize their activities on-line with the aid of software in the public domain, can in some situations be significantly more effective than that of profit-oriented enterprises (as Yochai Benkler convincingly shows in his book, *The Wealth of Networks*). Likewise, many new forms of non-market innovation are being elaborated right now in these on-line communities.

2. Within the growing combined quantity of traditional capital goods, the decreased potential for the exploitation of natural/environmental capital has been counterbalanced by the steady and steep increase of money capital and intellectual capital. Within this tandem the shift is occurring in the direction of intellectual capital as well as social wealth embodied in knowledge, whose valuation is increasing at more and more points in relation to the traditional forms of wealth. It nonetheless needs to be added that such substitutability has its limits. By the application of more intellectual capital you can significantly reduce the amount of fuel powering an airplane, but ultimately it will not take off on brain power alone, no matter how much.

3. The actors on the stage of economics, trained for all-out competition (especially those representing the pharmaceutical industry), find themselves ever more confronting situations in which they are incapable of securing the necessary resources for the research and development tasks that are essential for remaining competitive. They find it unavoidable to get together with their rivals in order to produce new knowledge collaboratively in so-called *knowledge centers*, established on a temporary basis and jointly financed. The same is true for science. Scientific programs at a supra-national level (such as the Human Genome Project) have proven that over increasing parts of the value-chain of knowledge production, the portioning out of collaborative effort is of basic economic and scientific interest, because the appropriation of knowledge and information is no longer a source of market or scientific advantage. In other words, under the emerging new circumstances cooperation beats the exercise of private initiative.

4. In the peaceful economic contention of nation states, increasing numbers of countries recognize that the key to their long-term competitiveness is a creative population, a more flexible new generation, one with an even more up-to-date organization of knowledge, whose nurturing justifies efforts never before expended.

As bureaucratic control, in response to the above pressures among other concerns, turns toward the child regarded as the potential carrier of new knowledge, thereby it also begins to liquidate itself. This is because *in pursuit of its own objectives, the existing control structure puts in motion processes which become the building blocks of the new control quality destined to replace the old one.*

It also becomes immediately persuasive that the drivers of change are not the pedagogue-heroes creating little knowledge and value oases within their own corners but the actors capable of reshaping the structure of institutions over global dimensions, at the system level. There is no local alternative, or rather, what exists is not a local alternative but a local perspective on a single reality, with the global being another and complementary perspective; beneath the two perspectives, there is a single functional reality.

So far we know little about the new control dimension, but it will surely overwrite the nation-state-based, bureaucratic interest structures evolved during the industrial era, so as to find its base instead in a global (planetary) level of coordination. It may be anticipated that the new control quality shall not be linked to a single decision center but will be kept functioning by many small centers. Not one actor shall set directives with plenipotentiary authority - the current situation as we have embodied it in the allegory of a personified *Instruction Policy* - but rather, many. Hence the new control quality will in part be a *multi-stakeholder* world, in part one of self-governance in the true sense of the term. As it appears in the *Empire* vision of Michael Hardt and Antonio Negri, it is a "*network form of power in that there is no single centre, but rather a broad set of powers that must negotiate with each other.*"

To a significant extent, the new world has to be a self-organizing system, but the way it self-organizes will be much influenced by our purposeful policy actions (see further below). An important question is how the many small nodes will be linked together? How is it possible to gather up the multitude of small communities into a hierarchy-free network in a way that enables central decision making where it is essential, but without infringing the autonomy of individual communities and their individual members? The objective function of the new control structure is the creative autonomous individual oriented to voluntary cooperation in small communities of mutual support, within and among these communities. Moreover, this quality cannot be restricted to benefit just the most talented individuals but must essentially pertain to all who graduate from the system of instruction.

The image of the pre-modern child is symbolized not by the rod for discipline but by the funnel for filling knowledge into empty heads. And though the funnel is preferable to the rod, by now the paternalistic child-image which underlies it, from which it had been taken, is ever more obviously inadequate. This state of affairs has, in truth, never been up to date at any time in the past but by now it has become downright damaging. For, since the digital explosion of the mid-Nineties, it can be perceived ever more clearly that the *screen-agers*, the children of the generation of the computer and the television set, in their capacity as self-assured masters of information-literacy are showing increasing competency in general and, with having taken possession of the knowledge-environment beyond the school,

in special areas as well. With what funnel should the computer-illiterate teacher stand next to a student who is engaged in directing the air traffic of the Chicago airport on a simulation game? *The symbol of the new control structure and the new child-image of the knowledge society is the post-funnel scene showing millions of tiny knowledge-furnaces. We believe that Freire would hardly object to this.*

In the context of the Third World the system of instruction is often still in a situation prior to the condition of bureaucratic control. In that context, it is often necessary to mobilize enormous efforts just for the physical establishment of the school as an institution - as for example in India because children's needs can in many places not be attended for lack of buildings and teachers. In the Third World even access to the carriers of knowledge is an everyday worry and available employment is a serious constraint on the output of the schools.

From this perspective, it is hard but not impossible to cast a glance toward the mountain peaks of the next system-level and adjust current actions accordingly. What needs to be recognized and accepted from the start is that *catching up is a hopeless program*. The strategic challenge is not to copy the patterns of the developed world that are just now facing replacement but rather to *find those joint actions that point toward a new quality everywhere*. The starting point for such joint actions must be the recognition of shared problems: global environmental challenges, the broadening of the sum of human experience by contributions of ancestral, indigenous knowledge, the iron bonds that tie humanity together in the production and consumption of goods which independently of frontiers increase the demand for those millions of tiny knowledge-furnaces.

The vision that we have presented offers the hope of welding students and teachers into small communities dedicated to the creation of science, whose work will proceed under international coordination. It offers the kind of image of the future and of children that points persuasively toward a new control quality. More precisely, it signals one possible direction and solution which might bring into being originally conceived and planned *micro-worlds* as instances of social innovation. The representatives of science will then enter the life of schools as new actors. Quite possibly, in other settings the increasingly successful new breed of social entrepreneurs, with their potential of ever more massive impacts, will be the ones to work out new operational approaches.

It is part of the overall message of liberation that the progressive closing of the digital gap, one of the world's especially urgent social problems, is automatically implied by the vision. And since, in the spirit of Freire, the emerging new process of science production has to address concrete pragmatic problems, it will undoubtedly have to focus, among other things, on the interrelated sustainability challenges posed by economic development and improvements in the quality of life. At the sub-regional level, pilot projects tackling acute environmental, ecological, or public-health issues can be initiated even before the emergence of system-level changes, as forerunners of eventual global programs, in order to create essential knowledge otherwise unattainable for lack of resources. One virtue of bureaucratic control is its ability to run such essential programs fast and efficiently - provided it can resign itself to visualizing the need not for a funnel but for ample problem-solving power when it looks at the students consigned to its care.

Cultural transition to sustainable development

The transition to sustainable development is strongly (and reciprocally) connected to the concern of integrating day-to-day school practice with the pursuit of creative scientific work by the students. Perhaps the most important link is our earlier observation that if we want to change the schools, what needs to be changed first is the economic and political order that provides their social setting. This also applies to the problem of transition to sustainable development - but with much greater urgency.

While we have seen that the coming of the knowledge society shakes up and progressively realigns social control processes all on its own, humanity's hand is clearly being forced by the approaching global ecological and social crisis which will inescapably lead to a crash if the world's current resource-consumption and waste-absorption overshoot is not reined in, and reined in fast. This means above all moving beyond the still widespread public denial about the depth and breadth of the economic and political changes involved.

This denial is apt to weaken more and more as the danger signs of the approaching crisis multiply. Today it is forests, fisheries, and global warming that demand attention; tomorrow it will be petroleum; soon it will be catastrophic cropland and pasture erosion and desertification in many areas, above all in the Third World. It is not that humanity will abandon its denial, it is rather that denial will abandon humanity under the weight of increasingly heavy blows from an overstrained social ecology. Popular insight has not yet caught up with the old adage as applied to its own case: the best way of getting the attention of a mule is to hit it over the head with a two-by-four.

What is decisive in this connection is that really important changes in the economic and political foundations of society are more likely to come about in response to threatened or incipient sustainability crises than under the pressure of institutional forces such as we have discussed in connection with the schools and science. Once major changes are, however, put in motion by sustainability imperatives, such institutional forces will greatly improve the prospects of further constructive change in both areas.

In addressing the key issues of working toward a transition to sustainable development, our premise is contrary to the prevailing conventional wisdom that technological change has the potential of solving all social problems. Instead, *we will posit that the needed technologies are both known - though they can be improved - and within the total resource availabilities of society, if these resources are properly mobilized, economized, and shared.* Thus the problem centers on a culture that fails to maintain broad social cooperation among autonomous individuals. For its solution, it requires establishing effective mechanisms that will negate antisocial, exploitative, and predatory arrangements, some of which are at the core of current political and economic institutions and thus at the core of resistances to a transition to sustainability.

The issue is *to identify and find ways of reinforcing evolutionary trends that can restructure the system to avoid a looming ecological and social crisis*, whose dark clouds can already be perceived coming up over the horizon. Free rider control, which humanity inherited from biological evolution, underlies the human cooperation that has carried us through the hunting and gathering stage of our ancestors, but by itself it is not enough for a transition from our contemporary world into sustainability.

When addressing the issues of sustainable development from this perspective, a necessary starting point, though not one that is widely recognized, is the structure of the human brain which underlies all social

decision making. Our modern brain with which we try to run a society of near-global dimensions, is still essentially that of hunters and gatherers. That brain had evolved genetically, in our specifically human form, over hundreds of thousands of years, to support closely knit, small communities of typically 100-200 individuals, tightly restricted to this size both by their communication processes and by their ways of obtaining sustenance from nature.

This connection is strongly supported by the work of Robin Dunbar whose regressions of group size against the size of the neocortex for primate species show that a group genetically in tune with the human brain has about 150 members. Communities of this size can be held together by individuals monitoring not only their own social relations but also those of others among themselves. Such links increase exponentially with community size, and thus a limit is imposed by what the brain can handle. The other limit is set by larger groups having to move from location to location ever sooner (to which there is a limit) because they exhaust the plant and animal resources of their immediate neighborhoods at a faster rate. The two limits on size had co-evolved.

It was the *much faster dynamic of cultural rather than genetic evolution* that has more recently brought about social relations of voluntary cooperation among mutually supportive autonomous individuals as a survival advantage. (Michael Tomasello posits that the immense gap between the capabilities of humans and apes has been created almost wholly by progressive cultural evolution based on one, or at most two, all-important genetic changes; he argues convincingly that the 8 million years separating us from the chimpanzees, fleeting in evolutionary terms, could not have allowed for more.) The newly evolved social relations established protection and respect for the autonomy of all community members, and especially for the authority of elders with more years of accumulated experience in handling crises, against the physical dominance of males in their prime. This is strongly suggested by the near-universal male circumcision rituals at puberty among hunting and gathering communities worldwide - a symbolic castration threat - backing up the community's categorical insistence on mature and respectful behavior upon crossing the threshold to adolescence and adulthood. Tied in with much concrete factual instruction about the natural environment in which the community was embedded and with challenging tests of persistence and courage, typically endured alone for days under potentially dangerous conditions, the goal of these rites of passage clearly was the creation of a peak experience meant to last a lifetime.

Likewise, it was cultural evolution that led not just to the containment but to the respectful and protective embedding of these communities in nature, with strong spiritual overtones. Our ancestors came to live in a natural world peopled with spirits who had to be treated with honor in order reciprocally to honor and support human needs. Here, we have more than a suggestion. We possess direct evidence of earlier wanton human predation that hunted to extinction large browsing marsupials in Australia forty thousand years back, and mammoths and mastodons in the Americas just ten millennia ago, as part of the first wave of human occupation of these continents. In both cases this had dire consequences, endangering the availability of necessary meat and thus the continuation of human communities once the human wave hit continental limits and there were no farther virgin lands beckoning. It is thus not surprising that only those hunting and gathering communities that evolved autonomous, mutually supportive cooperation as well as respectful

and protective relations with nature survived long enough to meet the anthropologists.

With agriculture, a relatively recent change of at most ten millennia ago, evolutionary advantage has shifted to ever larger human groupings which could no longer be firmly anchored in the cooperative social relations supported by what is still our hunting-gathering brain. Such larger social aggregates, by now approaching continental span, could and can hold together only on the basis of unstable power relations, set within hierarchically structured communities.

Early agricultural societies, though increasingly hierarchical, were still relatively benign because they were oriented to the spiritual principle of fertility. This applied to the soil bringing forth grain, in some peasant cultures still equated with life; it was symbolized by women's fertility, honored in the images of goddesses; and it led to women's higher status compared to men in many of these early agricultural societies.

Male warrior gods and sacred images of predatory beasts with bared claws and fangs appeared at later stages when armed conflicts between neighboring societies, originating in land degradation and competition over resources, put a survival premium on military strength and sheer numbers. This led to the exaltation of heroic virtues, to the demolishing of the social status of women, to relationships that were increasingly rapacious, exploitative, predatory, and violent within and between societies, and to a strong emphasis on *natalism* - families encouraged to have many children, or even women pushed to do so - by religions that had originated at this stage, including some of the world's great religions carrying over into our days. At times in some regions this developed into competitive procreation among antagonistic communities, giving rise to a truly destructive positive feedback cycle. The cycle involved population pressure leading to land degradation, an increase in mutual hostility among competing communities, search for an advantage through more births, therefore more population pressure, worse land degradation, more genocidal motivations, more insistent forcing of procreation, and still more population pressure. In instances from around the world, this cycle ran all the way to collapse - a warning to the wise.

Together with these negatives of an all-around social struggle for survival, and as a direct consequence of this struggle, the knowledge base supporting both productive and military activities of competing societies was deliberately and rapidly extended. This gave such societies the aspiration to more effective control over nature and recently, with modern scientific advances, the illusion of having attained such control.

Yet, the advent of modernity has not changed the deeply embedded hierarchical, exploitative, and predatory characteristics at the core of most advanced societies. It only shifted the mechanism of enforcing these negative human relations from the direct exercise of force and violence by those in political and military power, mostly to dominance as much as possible through money wealth and suitably manipulated market mechanisms by those commanding high shares of society's income and basic productive resources. Raw force, though, is still kept in the wings as the final arbiter.

Having reached the current, relatively high levels of insight into the processes of nature as well as the problems of human production and reproduction, the illusion of humanity's control, both over nature and over human nature, is wearing thin. The post-neolithic evolutionary advantages of numerically larger communities over smaller ones, together with the predatory cultural features that support it, are being trumped before our very eyes by the new evolutionary imperative that has been created by humanity's

running up against the limits of the global social ecology. Thus the hierarchical values under which societies operated in the past and which are still very much with us, with their implicit toleration of rapacious, predatory, and exploitative human relationships, are increasingly being recognized as no longer offering a survival advantage. Indeed, they are beginning to be seen ever more broadly as turning into a deadly liability, because they are carrying all of us globally toward a socio-ecological disaster and a consequent catastrophic crash.

For survival, humanity has to change gears and *enter into a process of evolutionary adaptation that moves forward by re-passing, at higher levels of knowledge and complexity, the course of an earlier cultural evolution*, the one that had carried our hunting and gathering ancestors to *human relations of autonomous and mutually supportive cooperation, with respectful and protective embedding of these communities in nature*.

The current, conflictive dynamic of our social world cannot continue, because nature is forcing our hand. Relations with nature are dramatically moving from the background into the foreground, with regional ecological crises threatening to merge and go global. For avoiding a catastrophic collapse, our primary engagement must therefore once again be with nature. Yet, the difficult evolutionary challenge that this poses turns out to be a blessing in disguise.

Since the two conflicts, that of society with itself and that of society with nature, are intertwined, we cannot solve the conflict with nature where the penalty for failure is very high, without also solving the conflict of human society with itself which has been with us for millennia and might otherwise well be left dragging on and on. We must thus begin working on the resolution of the intertwined conflicts from both ends, and do it fast, in order to initiate a transition toward a sustainable world while there still is some time left.

No practical way has so far emerged to create large-scale societies composed of non-hierarchical networks made up of the kind of small, cooperative communities that would be “naturally” in tune with the structure of the human brain, though as per our earlier discussion, we are beginning to visualize options. Yet, these options must pay off soon, as without deeply embedded social cooperation of ever more global reach, not forced by hierarchical compulsion but entered into voluntarily by autonomous individuals, sustainable development is unlikely to come about. And establishing such cooperation requires the elimination of the exploitative and predatory features at the core of modern societies under the guise of the institutions of market democracy or the planning bureaucracies of Twentieth Century socialism.

Without such a deep cultural change sustainable development cannot come about; certainly it cannot be expected to come soon enough to head off the threat of an ecological and social crash that some of the public now vaguely imagines as a possibility but can not yet feel in its guts, even though such a prospect is becoming progressively more pressing.

For the transition toward a culture of sustainability we need new human values and a new control mechanism, *predator control*, which is comparable to free rider control in supporting cooperation but goes beyond the latter in meeting a more advanced social challenge. The emergence of effective predator control mechanisms for all levels of modern society is a precondition of making possible a reorientation of human strivings for the support of a sustainable culture. This reorientation must move from compulsive population expansion at lower living levels in parts of the Third World and senseless over-consumption in many of the more affluent settings,

toward a high quality of life. The focus has to be on human relations, in the context of a stable world population of a size appropriate for such a quality of life.

When considering in what way effective predator control can come about in our days, it suddenly leaps to consciousness that *our ancestral hunting and gathering communities were free of predatory antisocial behaviors, yet apparently had no predator controls. Or did they?*

A moment's thought suggests that *the most effective predator control mechanisms are not the ones that identify and render harmless already established predators, but those that prevent the emergence of predators in the first place. Once this insight sinks in, the rites of passage at puberty, undertaken by our hunting and gathering ancestors, appear in an entirely new light.* This is especially so when we consider that respect for individual autonomy underlying voluntary cooperation, and the honoring and protection of the environment that had made possible the seamless embedding of ancestral humanity in nature, are products of relatively recent cultural evolution, rather than being hard-coded in human genes. How can we put in motion a similar evolutionary path in our contemporary world?

It cannot be done by policy planning; the evolving super-system of humanity in nature is far too complex, as shown by Donella Meadows in her posthumous "*Dancing with Nature*," to project one of its future states, let alone control its path toward a desired future. We can, however, hope to reinforce potential evolutionary paths that pop up like wild cards, suggesting the right direction.

In the context of our preceding discussion of sustainability issues, what we had earlier said about the *interpenetration of education and science* becomes such a wild card which offers major open leads into the future - perhaps the most promising among several. We suggest that it *has the potential of evolving into a truly effective predator control mechanism of the preventive kind which has strong resonances with the rites of passage at puberty undertaken by our hunting and gathering ancestors.*

This education/science wild card can provide an extraordinary amount of badly needed factual information concerning key variables of sustainability, with a dense local and regional coverage of detail otherwise unlikely to be properly evaluated and successfully digested. This can be seen as the modern counterpart, experienced by 12-18 year old students, of the *instruction component* of the ancestral rites of passage.

Equally important, the education/science initiative will bring home to these teenagers, as active participants in the scientific effort, a highly personal warning about the need to take with deadly seriousness the beginnings of the global sustainability crisis that humankind faces, on pain of their helping to bring about much worse to follow. This resonates with the *symbolic bodily threat* implicit in the ritual circumcision of boys at puberty, before they have had a chance to grow up into predatory males in their prime. A close look into the abyss is like personally sensing Nature in the process of circumcising immature humanity, causing pain that so far is limited and should serve as a warning. The pain touches on forests, fisheries, species loss, warming trends, desertification threats - no catastrophic global body blows so far but intimations of much worse to come unless there is a categorical commitment by humans to mature conduct.

The ancient rites of passage had been aimed at *protecting the authority of elders and thus indirectly the autonomy of all group members*, with the implicit purpose of furthering community survival. Its modern counterpart in the education/science nexus aims at making teenagers into autonomous members of the community, respectful of the autonomy of others and

motivated to cooperate voluntarily in matters of sustainable development, as well as other serious issues suggested by specific scientific tasks tackled in the schools.

Participation in the modern process as a whole, like the ancestral rites of passage, should create a *peak transformational experience* meant to last a lifetime. This has the potential of critically increasing the supportive motivation of future generations concerning the need for voluntary cooperation in all matters of concern for the community that are now often trapped in political dead-ends. While the modern experience provides no specific focus on predatory behavior exercised through money and wealth, it offers ample opportunity for critical thinking and a great increase in the *awareness of interconnections in society* that predatory forces would much rather leave hidden. It should thus *transform the broad social and political understructures needed for a transition to sustainability and these will in turn feed back on the control systems for education*, initiating a beneficial process of cyclic causation.

Who controls the beast to avoid the new Dark Age? - asks James Martin in his recent book, *The Meaning of the 21st Century*. It is the Transition Generation of young people, he answers, with their globally similar attitudes and thus readily accessible to socially constructive influences. For them, we wish to suggest, participation in scientific projects in the schools, oriented to sustainable development, can indeed serve as the rites of passage of adolescence, implanting voluntary, mutually supportive social cooperation as well as respect for the human autonomy of everyone in their local communities and every member of global human society.

One can sense millions of tiny knowledge-furnaces waiting to be stoked up.

We wish to close with the grateful recognition that the possibilities developed in our discussion are spiritually grounded in Paulo Freire's core idea: transformation of the world by education as a process of liberation. In his phrasing: "There is no true word that is not at the same time a praxis. Thus, to speak a true word is to transform the world."