

**BRAZILIAN BIODIVERSITY: THE INTERNATIONAL CHALLENGE**

The third edition of the **Oxford Paperback Dictionary** published in 1988 includes the word **bioengineering** but not the word **biodiversity**. This absence certainly does not mean the concern and the study of the diversity of life-forms didn't exist at that time. In fact the word was introduced in 1986 by Walter Rosen, who had conceived a National Forum on BioDiversity, held in Washington under the auspices of the National Academy of Sciences and Smithsonian Institution. And it seems it was created to name a new issue. As E.O. Wilson, the leading biologist puts it: "The forum coincided with a noticeable rise in interest, among scientists and portions of the public, in matters related to biodiversity and the problems of international conservation. I believe that this increased attention, which was evident by 1980 and had steadily picked up momentum by the time of the forum, can be ascribed to two more or less independent developments. The first was the accumulation of enough data on deforestation, species extinction, and tropical biology to bring global problems into sharper focus and warrant broader public exposure. (...) The second development was the growing awareness of the close linkage between the conservation of biodiversity and economic development. In the United States and other industrial countries, the two are often seen in opposition, with environmentalists and developers struggling for compromise in a zero-sum game. But in the developing nations, the opposite is true. Destruction of the natural environment is usually accompanied by short-term profits and then rapid local economic decline. In addition, the immense richness of tropical biodiversity is a largely untapped reservoir of new foods, pharmaceuticals, fibers, petroleum substitutes, and other products."

In this way Wilson's remarks allow us to see that, from the start, biodiversity appears as a complex issue, as an object of interdisciplinary interest which demands the attention of natural sciences as well as human sciences including economics, ecology and development. But another factor should be taken into account: the very situation which gives birth to the biodiversity issue demands urgency, due to the vertiginous changes and destruction by man of habitats favourable to the diversity of life-forms for thousands and thousands of years. In some sense, if biodiversity appears as an academic issue, however it immediately encompasses many other spheres, becoming an economic, political, technological, physophysical and perhaps religious question.

As everybody knows, the rainforests are the core of this question, not only because they concentrate the world's richest habitats of species, and those which are in greatest danger, but also because tropical moist forests serve as the ideal paradigm of the larger global crisis. Gathering data and information from many different sources, Norman Myers gives us an idea of the scope of the problem; we can then realize why these forests became a world concern: "Tropical forests can be considered the greatest celebration of nature to grace the face of the planet in four billion years of life's existence. While covering only 6 per cent of Earth's land surface, they are estimated to contain at least 70 per cent and possibly even 90 per cent of Earth's species. Half a square kilometre of Malaysia forests can feature as many trees and shrub species as the whole of the United States and Canada. A single bush in Peruvian Amazonia has revealed as many ant species as in the British Isles. As the

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forests go, so do their species. In just 4 per cent of tropical forest's expanse and 0.2 per cent of Earth's land surface, at least 15 per cent of Earth's plant species are threatened with extinction by the year 2 000 or shortly thereafter, together with hundreds (possibly millions) of animal species. (...) The mass extinction overtaking the planet's biotas is occurring almost entirely within tropical forests."

It happens that Brazil leads the group of thirteen megadiversity countries. Philip Fearnside gives us the figures for this position. The so-called Brazilian Legal Amazonia has a surface of about 5 million square kilometres, that is 60 per cent of the national territory. 1.9 million square kilometres are dense forests (38% of the region); 1.8 million square kilometres (36% of the region) is occupied by non-dense forests, and 7 hundred thousands square kilometres (14% of the region) by open vegetation, such as natural fields; the rest (12%) is occupied by secondary vegetation and agricultural activities. The Amazon is therefore a region of continental dimensions: half the size of Europe. Nowadays there are 8.5 million square kilometres of tropical rainforests in the world and they can be found in South America, Africa and Asia; of these the Brazilian Amazon has about 40%.

The Amazon rainforests are distinguished by their biodiversity, rich in biological species and in ecosystems, as well as genetic diversity within each species. Meanwhile in the Amazon forests more than 2 500 tree species are known, in the temperate forests of all France only 50 species can be found.

This biodiversity wealth is internationally recognized. However, it is in great danger. According to Philip Fearnside, the annual rates of deforestation were in the average about 22 thousand square kilometres from 1978 to 1988; in 89, of about 18 thousand square kilometres; and in 90, about 14 thousand square kilometres. For better or for worse, biodiversity is, first and foremost a Brazilian question.

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Pointed out in the middle of the 80s' and linked since the beginning to the problem of tropical deforestation, the biodiversity issue added to two other main themes which emerged at the same period in the growing environmental movement: the greenhouse effect and the ozone layer depletion. As far as deforestation appeared to be one of the factors of climatic changes, all these problems began to be intertwined, drawing a catastrophic panorama which placed Brazil in a very uncomfortable position.

We do not have enough time to consider the controversial discussion that took place around the contribution of Brazilian deforestation to global warming, etc. But it should be recalled that the discovery of the biodiversity wealth in Brazilian territory was partially compromised. In a certain sense, meanwhile this wealth was becoming evident to everyone, it seemed irreversibly affected. That is why at the first moment discussion was concentrated in a question: How to preserve it? Which was translated by another question: How to stop deforestation?

The debate about environment destruction was launched by the historical book by Rachel Carson, *The silent spring*, in 1962; concern was intensified by acid rain,

among other factors, which gave rise to the Stockholm Conference ten years later; but we could say the problem remained within the industrialized countries of the North, at least as regards public opinion. The nuclear accident at Tchernobyl, by the end of the 70s' drew attention to the environment disasters which were being engendered in the socialist nations. On the other hand, something new had happened: floating across the European continent and spreading fear of contamination, the radioactive clouds showed that ecological catastrophes ignore national boundaries and the ideological divisions of the cold war. Finally, fire proliferating in Brazilian rainforests involved the Third World in the environment agenda, and completed the picture thus making it a global question.

Brazilian Amazon deforestation was seen as a major menace to climate change because it could help to compromise life outside the tropics. It was a direct, a very concrete menace. But biodiversity extinction was felt as a distant, indirect and indefinite menace. In other words: the first menace puts our own life at risk, whereas the later invades others lives.

Such a trend must be taken into account if we want to understand why the voices warning about the critical situation of tropical biodiversity needed to justify the preservation efforts and to list the advantages we could get if we were not indifferent to the loss of life-forms. It seemed as if these species had no value unless they proved to be valuable for modern man's life. Let us hear some of these voices:

James Nations argues: "The day may come when ethical considerations about biological diversity become our most important reason for species conservation. But in the meantime, if we want to hold on to our planet's biological diversity, we have to speak the vernacular. And the vernacular is utility, economics, and the well-being of individual human beings. In the 80s, the question seems to be, "What has biological diversity done for me lately?" The good news is that the answer to that question is, "Plenty, and more than you realize." Our lives are full of examples of the logic of preserving the plants and animals that we depend upon as a species."

Norman Myers explains that apart from the scientific, aesthetic, and ethical values of biodiversity, these losses affect the immediate material welfare of people throughout the world. One in four products sold by pharmacies, whether medicinal or pharmaceutical, is manufactured from materials taken from tropical-forest plants. These products include antibiotics, antivirals, analgesics, tranquilizers, diuretics, and laxatives, among many other items. (...) Commercial sales of these diverse products are now worth around \$20 billion a year world-wide..

Norman Farnsworth recalls that, according to the World Health Organization, 80 per cent of the people in developing countries rely on traditional medicine for their primary health care needs, and about 85 per cent of traditional medicine involves the use of plant extracts. Kenton Miller and Laura Tanglely had also tried to draw attention to nature's pharmacopoeia importance: "More than 260 South American plants appear to have potential fertility control applications. Of the 3 thousand plants identified by the National Cancer Institute as having anticancer properties, 70 per cent live only in the tropics. The possibilities for developing still more new drugs from tropical forests should figure heavily in any calculation of the

forests true worth."

Emphasis on biodiversity medicinal value is a constant theme in the warnings of specialists and environmentalists. But there are other "benefits of biological diversity" that should be considered - those related to agriculture and industry. We could take many examples throughout the pages of specialized literature to demonstrate what tropical biodiversity has done for us all. Nevertheless its contribution could be much greater, if we think, with the World Resources Institute, that **less than 1 per cent** of tropical plants were investigated for potential uses! As a result, we ignore rainforest biodiversity because we do not know what it is, because it has not been scrutinized by modern science and because traditional knowledge is disappearing before the value of forest life-forms is recognized; and by the same token, we ignore what biodiversity could be - that is why we deplete the future's wealth without even anticipation of its benefits.

It is evident this state of affairs should be largely known and discussed. The biodiversity issue should touch public opinion, and awake the conscience of everyone. Aware of the urgent need to share these concerns with a larger number, Lester Brown, President of the ecological **think tank** Worldwatch Institute, invited the specialists, at the National Forum on Biodiversity: "(...) scientists are going to have to become activists. (...) We've got to move the issue from the scientific journals into the magazines and the popular press (...)."

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Once we hear the voices defending the preservation of rainforest biodiversity, and mainly Brazilian Amazon diversity of life-forms, once we become conscious of this urgent need, we tend to agree with James Nations and to speak the vernacular that can be understood by everybody. I mean, we tend to talk money.

In a book called **Saving the planet**, issued just before the Conference in Rio, and certainly addressed to that audience, the Worldwatch Institute tries to speak in economic terms. "Our economies are engaged in a disguised form of deficit financing: processes such as deforestation and overpumping of groundwater inflate current output at the expense of long-term productivity. In sector after sector, we violate fundamental principles of environmental sustainability. Relying on an incomplete accounting system, one that does not measure the destruction of natural capital associated with gains in economic output, we deplete our productive assets, satisfying our needs today at the expense of our children. As economist Herman Daly puts it, "there is something fundamentally wrong in treating the earth as if it were a business in liquidation"."

The Worldwatch Institute premises seems to correspond to what happens actually. But if we accept it, some naive and evident questions immediately impose themselves. Firstly why is that so? Secondly, why don't we evaluate what we are losing? The Worldwatch Institute remarks suggest we accept destruction because our accounting system does not take into consideration natural capital. But we could ask: Why does economics disregard it? And why is nature not considered as capital? If it was, we could look for the economic value of water, air, fire, rain, wind... If it was, ecologists would not question anxiously: How can value be assigned to rainforests?

How can the value of standing forest be considered greater than the value of cut down forest?

Therefore, to speak about natural capital presupposes a sort of operation which converts something that has qualitative value, and as such is unique, into something that has a quantitative one, something that has a market value. But we could suppose that tropical forests are destroyed precisely because they have only a qualitative value, an extra-economic value, a vital value, and as such, **do not have value at all**, I mean do not have economic value. Up to the end of the 80s, the Brazilian state granted subsidies and other inducements to everyone who wanted to burn the forests in order to "improve" the land, in other words in order to assign some value to it as cattle ranch - Myers estimates the Brazilian government spent \$2.5 billion in subsidizing ranchers' investments. And then it must be recognised that this very act of burning forests could be a value increasing operation! In this sense, the very human act of destroying was creating economic value. "The Amazon forest, writes Philip Fearnside, is being destroyed basically because for individual economic agents the immediate economic value of the forest is smaller than the value of alternative uses of soil, including speculative usages."

Deforestation in tropical countries, and mainly the Brazilian Amazon deforestation raised the biodiversity issue, and with it, a difficult problem for biologists, botanists and zoologists. They were asked to establish scientifically the biodiversity value as "natural capital". But the specialists could not solve this problem. As Hugh Iltis puts it: "(...) I have no patience with the phony request of developers, economists, and humanitarians who want us biologists to "prove" with hard evidence, right here and now, the "value" of biodiversity and the "harm" of tropical deforestation. Rather, it should be for them, the sponsors of reckless destruction, to prove to the world that a plant or animal species, or an exotic ecosystem, is **not** useful and **not** ecologically significant before being permitted by society to destroy it. And such proof, of course, neither they nor anybody else can offer!"

Such a radical answer reverses immediately the sense of the question, declaring the responsibility of economic processes for the destruction. Economist Michael Hanemann, however, takes a different path.

Hanemann does not start from the advantages of biodiversity preservation; instead, he starts questioning the reasons for destroying it: Is economic growth harmful to biological diversity? What are the reasons why it may turn out to be harmful? How can harmful impacts be avoided? What institutions are required to ensure a better outcome? These questions that economists ask in connection with biodiversity involve a mixture of normative and positive analysis. For the normative issues, Hanemann recognizes economists do not have a theory to explain the fundamental role of equity considerations and value judgements they imply. But that is not the case of the positive issues. Hanemann states that, as resource economists, one of their direct obligations is to measure, explain, and predict how individuals and institutions manage natural resource systems, value biological diversity, and make decisions affecting its preservation.

Economists invoke a series of arguments in order to explain why anyone may

rationaly choose to deplete natural resources and destroy ecosystems. The most important argument, says Hanemann, is intertemporal preferences and discounting - the same argument Worldwatch Institute called for in **Saving the planet**. In contrast to conventional commodities, Hanemann explains, a distinctive feature of natural resources is that they are not instantly renewable; they can be restocked, if at all, only with time and subject to the constraints of biological processes. Consequently, harvesting these resources involves a trade-off between present benefits and future costs that depends on how the latter are discounted relative to the former. In other words: if we consider the future costs/present benefits relationship, we may conclude the price to pay is too high; but if we do **not** consider this relationship we might be withdrawing more funds than available. The problem is that, if we consider the future costs/present benefits relationship, we may decide to sacrifice present consumption opportunities to benefit future generations, choosing what is good in collective terms; but if we do **not**, we may consume individually, right here and now, all the wealth we find at our disposal. Hanemann calls this "a prisoners' dilemma situation: conservation may be the optimal strategy collectively, but it is not a dominant strategy for each individual privately.

Hanemann's analysis is very important for us because it outlines a contradiction between the environmental and the economic imperatives. Since we are prisoners of a dilemma, it is not enough to be conscious of the scope of deforestation; we might still be able to overcome the dilemma, changing our individual strategy. That is why this analysis allows us to understand why Norman Myers concentrates his attention on the **shifted cultivators**, these pauper and land-hungry rural workers who burn the Third World forests to survive; and also, to understand why Alan Durning addresses the all-important consumers of advanced capitalist societies. These groups are emblematic images of the dominant individual strategy and express, through their acts, the value each really assigns to ecosystem preservation. It is clear that this value, even if it is not quantified, is negative. The value they **should** assign (the other option of the dilemma) is only left to an ideal ethic.

Nevertheless, let us come back to Hanemann and see what happens if instead of trying to evaluate the damage economic growth can bring to biodiversity, we try to foresee the advantages of preserving it. "With respect to the positive analysis of ecosystem values, writes Hanemann, it is useful to distinguish between the environment as a marketed good, on an input to the production of marketed goods, and the environment as a nonmarketed good of concern to people in its own right." Economists deal with the first situation; Hanemann, however, remarks that environmental economists have not been paying attention to economic analysis, which figures out the market price of alligator handbags, for instance, and multiplies that by the reduction in the quantity of alligator handbags resulting from the destruction of alligator habitat. Environmental economists are interested in markets not because they want to use market prices to multiply something but because they are interested in measuring the preferences of individuals and ascertaining their trade-offs between environmental resources and money or conventional market commodities. But according to Hanemann, "organized markets are one forum in which people reveal their preferences through the choices that they make - **but markets are not the only forum, and they are not essential to the enterprise of environmental valuation.**"

Moreover, individual preferences are also problematical. Hanemann questions the very option of environmental economists and its limits, to conclude : "Lastly, the postulate underlying the entire enterprise of positive analysis (...) is itself a value judgement and one that can be questioned. Consumer sovereignty, and the notion that people may have consistent and stable preferences, can be challenged. People may be ignorant, ill-informed, or fickle in their attitudes. Why should we care about what they think? A justification comes from the utilitarian ethical system that mainstream economics embraces. The point I want to emphasize here is that this question defines both the strengths and the weaknesses of economic analysis. In their positive analysis, economists are essentially holding a mirror to society."

Hanemann shows the problem of biodiversity economic value ends in an ethical question. David Ehrenfeld sees this problem itself as the problem. In a text called "Why put a value on biodiversity?", the biologist argues that the discussion devoted to the value of biological diversity tells us a great deal about why biological diversity is in trouble. In previous times, he states, valuing diversity would have been thought both presumptuous and a terrible waste of time. Ehrenfeld believes the dominant economic realities of our time - consumerism, technological development, the growth of human populations, the increasing size of governmental, industrial and agricultural enterprises - are responsible for most of the loss of biological diversity. This reality is so omnipresent that survival itself is viewed as a matter of economics. In this sense, it is hardly surprising that even conservationists have begun to justify their efforts in economic terms. Ehrenfeld warns biologists, botanics, zoologists: "It does not occur to us that nothing forces us to confront the process of destruction by using its own uncouth and self-destructive premises and terminology. It does not occur to us that by assigning value to diversity we merely legitimize the process that is wiping it out. (...) it is certain that if we persist in this crusade to determine value where value ought to be evident, we will be left with nothing but our greed when the dust finally settles."

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It seems that the effort to give to the Brazilian biodiversity wealth an economic expression is now undermined by the impossibility of evaluating it as "natural capital". Such problem reveals the ambiguity of wealth appearing as either vital or capital, either real or virtual, either physico-chemical agent or a living entity; and it reveals also the complexity of this shifting question. Nevertheless, we must keep in mind that, while the discussion takes place within the conservation movement, the aggressive mechanism fueled by shifted cultivators and by the all important consumer keeps up deforestation. Every day the force of a predatory economy moves the arms of thousands of poor people in tropical countries and makes them fell trees; and also moves the arms of thousands of Japanese people, for instance, who throw away the chop-sticks after their meal and promote, through their wasteful action, the destruction of Malaysian forests. And also, beyond the discussion, other facts and trends create new realities which will concern tropical biodiversity.

As everybody knows, the old battle, technology versus nature is such an omnipresent mind construction when we think about the environmental crisis, that

technology. This is a major change of perspective for some environmentalists, but it is one that is occurring."

There are six main characteristics of this technology which could reconcile environmental and economic values: firstly, it should be sustainable; secondly, based on a safe and inexhaustible supply of energy; thirdly, highly efficient in the use of energy and other resources; fourthly, highly efficient in recycling and the use of by-products; to be intelligent; and **alive**.

From all these characteristics, the last is obviously the one which concerns us most. If we believe in R. Olson, we are facing a new field, ecological engineering, and a new category of technology, "living machines", whose design emulates the principles used by nature itself and whose performance is adapted to changing environmental conditions, as much as living systems. Therefore, green high technology would combine ecological engineering with genetic engineering, creating an environmentally advanced technology providing enormous business opportunities in the 1990s and over the next 50 years.

The new perspective announces an almost unbelievable future. Maybe Olsons's optimism should not be taken for granted; but perhaps it would be interesting to look for the first signs of this new relationship between environmental and economic values.

These signs are found, of course, in Japan, the country where innovation in high technologies appears first as a future dominant trend. And it seems there is some evidence partially supporting Olson's perspective. Biotechnology is the most recent high technology area of commercialization the Japanese government is trying to stimulate through public and private sectors. In addition, the two new research programs sponsored by MITI and other organizations are the Human Frontiers Plan and the New Functionaal Element Program. The Human Frontiers Plan has three main objectives: 1) innovation of production processes based on an understandig of analogous biological/biochemical processes; 2) development of new information-processing and control systems that funcionally resemble animal nervous systems; and 3) development of power systems modeled after the locomotor systems of biological organisms. The New Functionaal Element Program is composed of three elements: 1) new materials, such as membranes, plastics, synthetic metals, alloys and ceramics; 2) biotechnology, such as bioreactors, cell cultivation, and recombinant DNA; and 3) new fonctionnal elements, such as supelattice devices, 3-dimensional integrated circuits, and bioelectronic integrated circuits.

Such initiatives suggest the Japanese are investing seriously in biotechnology and new materials. It is common sense to say that the Japanese developed their "human resources" because they had limited national natural resources. The fact is that now their scientists and technicians can open a new field with enormous possibilities. Arthur Humphrey remarks that "the Japanese regard the microflora in their soil as a natural resource and, therefore, have aggressively added to their culture collections from soil throughout Asia. As a consequence, the Japanese have developped a cadre of technical help skilled in the art of microbial screening that is readily adaptable to genetic engineering and associated screening techniques."

Biotechnology and the so-called "new materials revolution" have also recently introduced new expressions in the techno-scientific lexicon, such as **materials design** and

**custom materials.** This means that molecular structures can now be artificially manipulated to produce specific material for specific uses. It is also hoped, in the future, biological processes will come to replace chemical processes in the manufacture of materials. Biotechnology and the new materials revolution belong to the newly emerging techno-paradigm shift led by high technologies.

A survey held by Fumio Kodama in 1990 gives us more information to believe biotechnology and the new materials revolution are the next wave of high technologies. He asked scientists and technologists representing seven technological fields to list those fields, outside their own, from which they most eagerly anticipated new advances. The seven technical fields consisted of new materials, biotechnology, electronics, information processing, energy, aerospace and construction/transportation. The shift from the short to the long term can be seen by some figures. Within the next five years, the greatest expectations were held for electronics (72% of all possible responses), followed by new materials (66%) and information processing (61%); however, relatively little was anticipated from biotechnology (11%). But in the longer term - 5-10 years - great expectations were held for new materials (73%), electronics (60%) and biotechnology, now performing a dramatic leap to 48%!

Signs coming from Japan seem to point to the opening of big economic opportunities to biotechnology and the new materials revolution. And also, it must be remembered that geneticists and zoologists attended for the first time the annual meeting of the Materials Research Society, held in Boston last December. They had come to preach the wonders of biomimetics, the science of mimicking biological materials. The idea is to study natural products for clues to making materials stronger, more durable, more flexible - potatoes, webs, mussels are the models. As a molecular biologist puts it: "Nature comes up with solutions that are very novel and clever. Its successes have survived millions of years of natural selection. Its failures are extinct."

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These examples show us how, through new materials revolution, the relationship between nature and artifact is actually being viewed in a new perspective, which reevaluates nature from a technological approach. And also, they show how, through biotechnology, the relationship between the organic and the mechanical is changing. The living machine is emerging from the "vital machine".

The expression is used by David Channell. Analyzing the relationship of mechanical and organic since the beginning of the XIX century reveals a progressively less polarized evolution and a growing interpenetration between the two poles, Channell concluded we are witnessing the emergence of a completely new world view, the **bionic world view**, which refers to machines that replace organic processes as well as organisms that replace machines. "I propose that we create a new concept - says the historian - the **vital machine** - as a way to symbolize the bionic world view. The vital machine represents a dualistic system in which components or subsystems at one time thought to be organic or mechanical lose their individual identities and become part of a new category of phenomena." "The concept of the vital machine provides a model for understanding the revolutionary developments that are emerging in the XXth century (...)."

In 1984 the novelist Thomas Pynchon had already warned: "(...) the next great challenge to watch out for will come (...) when the curves of research and development in artificial intelligence, molecular biology and robotics all converge." In 1991, Channell is already able to trace the vital machine genealogy through the fusion of artificial intelligence with biotechnology. When the gene provides a model for computer, and the computer provides a model for gene, symbiosis can become real through the **biochip**, that is the possibility of creating computers using microchips that are composed of proteins rather than silicone.

Therefore, part of Olson's vision, the one which refers to a new category of technology, "intelligent and alive", is appearing on the horizon. But the "greening of high tech" needs this technology to be integrated with ecological engineering, in order to get a positive connection between environmental and economic values. We should then look for the signs of this positive articulation.

In the search for a "bionic ethic", Channell adopts poet Richard Brautigan's proposal of a "cybernetic ecology". But there are other opinions, and at least for the moment they seem more reasonable. The ethical issues created by technological development are the subject of intense discussion. In order to counterbalance Olson and Channell's optimism, it is worthwhile evoking an essay analyzing precisely the hypothesis, according to which, biotechnology is led by repulsion towards nature, and not by the aspiration of an harmonious union with it. In that sense, biotechnology would be one of the greatest manifestations of "technological gnosticism".

Herminio Martins, who works on this hypothesis, writes: "The expression "technological gnosticism" may seem an oxymoron as gnosticism is usually understood as involving abhorrence of the organic, repugnance for the body, aversion for the natural (...) and a metaphysical pathos in which the "viscosity" of things is felt as radically inimical to spirit. Technology entails manipulation of the material world and thereby appears inherently counter-gnostic. However by the superficially paradoxical expression of "technological gnosticism" is meant the wedding of technological realizations, projects and aspirations to the characteristically gnostic dreams of radically transcending the human condition (...)." Martins underline the ironical paradox of our contemporary situation: the fabrication of artificial life-forms is held in a planetary context in which biodiversity is far from being exhaustively listed, and in which species are disappearing at an accelerating rate. But it seems the very existence of biotechnology could play an active part in the whole issue, through the overthrowing of the natural boundaries between species and the acceleration of the processes of genetic and somatic change. After all, the technological tempo of bioengineering replaces the slow pace of the bioevolutionary time-frame through direct intervention in genomes. Martins writes: "The laments for the destruction of natural habitats and natural biospecies are often dismissed with the claim that technologies can provide precisely engineered substitutes for any and every "natural" kind that is lost. This is a claim made not just by technoscientific authorities but also by mainstream economists whose theodicy of economic growth constantly relies on a "fallacy of infinite substitutability" and the last-resort appeal to the fact that some people actually like plastic trees."

Martins's analysis seems quite useful to us because it reveals a possible incompatibility between nature and biotechnology, which is "solved" in favour of the later every time economic criteria promotes fast and productive artificial processes to replace the

slow and limited natural processes. The question then is: what sort of connection biotechnology has been establishing between environmental and economic values?

The question deserves attention because it is relevant to tropical biodiversity, and mainly Amazon forest biodiversity. As we have seen earlier, it has been attempted to assign an economic value to the diversity of life-forms, to enhance them as "natural capital"; and as we have seen earlier, the specialists faced huge difficulties doing this. Perhaps it is actually impossible to evaluate the wealth of Brazilian biodiversity in its entirety, and even in each of its unaccountable species, but it is possible to have it powdered into microscopic fragments, in order to seize some of these minimal unities and to assign to them an economic value which could make millions on the world market. It happens that biotechnology is precisely the possibility to convert something which had by right an environmental value into something that can have in fact economic value. In short, perhaps biotechnology does not perform a connection between these values, but rather a conversion from one another. Biotechnology has been a special way of removing biodiversity from itself and of transforming it into an "artificial capital"!... Biotechnology seems to be the skill through which life itself is taken from the diverse life-forms to be incorporated as raw material in a sophisticated and perverse industrial process accounting for the creation of the most promising market: the biomarket.

Aware of the movement drawn to international level by the opening of a new field for global capitalism action and conscious of what is at stake in the biotechnology-biodiversity relationship, Vandana Shiva allows us to go on in our search.

She writes: "As biology takes the centre stage of industrial civilization with the emergence of the new biotechnologies, biodiversity conservation also moves centre stage for the green movement."

Therefore, Vandana Shiva identifies the biotechnology-biodiversity relationship as the main axis through which the environment will confront economics. She knows biodiversity wealth is seen as a strategic raw material for the industrial production of food, pharmaceuticals, fibres, energy, etc. But that is not enough to make a positive link between technology and the diversity of life-forms; in her view, we should not agree with the idea according to which biotechnology will lead automatically to the protection and the conservation of plant and animal species, because it has been producing uniformity and homogeneity. How then could we expect it to conserve diversity?

Vandana Shiva believes the dominant paradigm of production creates an imperative for uniformity and monocultures. The major goal of modern production is to get the maximum productivity; but it happens that in all the sectors where modern production deals with plants and animals - agriculture, forestry, animal husbandry and fisheries - the search for productivity leads to uniformity and monocultures. That is why different cultures were replaced by soy in Southern Brazil or by rice in the East, and why natural forests were replaced by eucalyptus. But also the strategy requires to promote, in each species, only the variant more immediately profitable. As a consequence, modern agro-business tends to conceive natural diversity as a sort of raw material reservoir from which some species are picked as inputs for production; proliferating everywhere, these species tend to be dominant, and so, to eliminate other species. The obvious conclusion of the whole process is that modern production is, itself, based on the destruction of the diversity of species and of genetic

diversity inside each species. In this context, biotechnology is, in essence, technology for the breeding of uniformity in plants and animals.(p.20) Shiva writes: "The irony of plant and animal breeding is that it destroys the very building blocks on which the technology depends. (...) In the words of Professor Garrison Wilkes (...), this is analogous to taking stones from the foundation of a building in order to repair the roof. This strategy of basing productivity increase on the destruction of diversity is dangerous and unnecessary."

Willing to explain how biotechnology has been dealing with biodiversity, Vandana Shiva uses Jack Kloppenburg's analogy of the seed. According to him, to the peasant and to the forest dweller, the seed is both a "product" and a "means of production", that is grain that will be eaten and grain that is reintroduced as seed in the next crop. Thus, as a means of production, this seed draws a circle: the cultivator reinvests it in the production process, and in this sense the seed represents "capital", with a simple biological obstacle; given the appropriate conditions it reproduces itself and multiplies. Modern plant however, and mainly biotechnology, has primarily been an attempt to remove this biological obstacle, breaking the circle into two vertical lines: an ascendant linear flow of free germoplasm from farms and forests into corporate labs and research stations, and a downward flow of modified uniform products as priced commodities from corporations to farms and forests. In this process, the natural seed that was simultaneously product and means of production is transformed into raw material.

This metamorphosis has, of course, many implications. Firstly, the self-regenerative seed becomes sterile: it does not **reproduce** itself, while by definition, seed is a generative resource. Through technological transformation, biodiversity is transformed from a renewable into a non-renewable resource. In addition, this seed does not **produce** by itself: it needs the help of inputs to produce, and whether a chemical is added externally or internally, it remains a new external interference in the ecological cycle of the reproduction of the seed. Secondly, through biotechnology, the whole is rendered partial, and the partial is rendered whole - technology treats self-regenerative seed as "primitive, raw" germplasm, and the seed that is inert without inputs and non-reproducible as a "finished product". Finally, through this shift from the ecological process of reproduction to the technological process of production the seed is taken way from the peasant and forest dweller hands to be delivered to the corporations.

Now there are in fact two sorts of seeds, two races. The native seeds, which evolved through both natural and human selection and are produced and used by Third World cultivators, became incomplete, devalued, unproductive, mere raw material, and as such are called **primitive cultivars**. And the varieties created by modern plant breeders in research centers of the First World or in transnational seed corporations are called **advanced** or **elite**.

The words employed by biotechnologists express accurately what happens in the seed metamorphosis. In fact, the disruption of the ecological circle into two technological linear flows - ascendant flow of germplasm and downward flow of finished products - realizes two operations; the first operation neutralizes the ecological value of the seed, devalues it and degrades it to the rank of valueless raw material; the second operation benefits the seed, adds a value to it, assigns to it an economic value. As the biologist puts it, **"raw" germplasm only becomes valuable after considerable investment of time and money**". Vandana Shiva draws the necessary conclusion of the whole process: "The "value added" in one domain is built on the "value robbed" in another domain. Biotechnology development thus translates into

biodiversity erosion and poverty creation."

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The devaluation of life-forms and their reduction to mere raw material corresponds to the introduction of the patent system to genetic resources and to the protection of intellectual property for bioproducts created artificially. Through biotechnology life can now be owned, life can be monopolized. If we recall that the total contribution of wild germplasm to the American economy has been, according to P. Mooney, US\$66 billion, which is more than the total international debt of Mexico and Philippines combined, we can understand why transnational corporations are so greedy, and also why tropical forests are seen as "gene banks", why there are "gene hunters", why an observer remarked recently: "In all of this there is a sense of something wrong. Japanese companies are collecting herbs in Asia. American companies are after plants in Latin America. European companies are opening up research centres in Brazil and India. There is money to be made. But none of it will be made by the people who first discovered the value of these traditional medicines."

It was once said that green capitalism slogan is "save the planet and make money at the same time". Perhaps it won't be possible to save it, if these two intents revealed incompatible, as it is suggested by the seed metamorphosis. The salvation of the planet is an open question, but it seems the process of making money with the diversity of life-forms is really engaged. Biotechnology will exploit biodiversity through the patent system and the intellectual property right.

The possibility of patenting different life-forms emerged during the same decade which brought the biodiversity issue to the centre stage, but it was prepared by a series of imperceptible steps in the previous decades. However, in 1980 a rupture occurs when the Supreme Court of the United States ruled that the new bacterium created by genetic engineering by Ananda Chakrabarty could be patented. Until then living beings were not patentable because they were "products of nature"; but Chakrabarty's micro-organism was a "manufacture" according to the law, and thus, could be protected by a patent. The impact of this decision was enormous in the corporations research labs. In 1985 was patented the first plant, and in 1987 the first animal.

The decision to patent a genetically modified mouse recalls that "the right of patenting cannot be applied to human beings". Nevertheless, some time later the Moore affair changed the matter. Moore was an unique case of leukaemia. Admitted to a hospital in 1976, his healers soon realized he could be very productive in research terms (about 3 billion, in 1990 dollars). They decided to share his blood, semen, spinal cord, skin and tissues and for seven years collected genetic fragments from his body. Genetics Institutes and Sandoz provided the funds for research and ensured the margins of profits for everyone. When Moore died, he left a lineage of cells proliferating in a lab and nine pharmaceutical products. But before that Moore discovered he was being used and sued his healers... claiming on his right to his cells! The judge recognised his right. Marie-Ange Hermitte, specialist in the patent issue, analyzes the case:

"For a long time hospital waste was valueless. (...) But the situation has changed:

organs, veins, placentas, tissues can be diversely recycled by industry, specially hormones, antibodies, genetic fragments, lymphokins can be isolated, sometimes multiplied, transforming the body and its wastes into an actual raw material."

As usual, this raw material is valueless. During the proceedings, the healers argued that the material collected from Moore's body should be compared to hospital waste and that its juridical status was the same of an "abandoned thing", since the link with the person had been broken from the moment it had been collected. In their point of view, to recognize Moore's right meant to assign a value to something that was valueless. For them, value could be added only through the specialist knowledge which detects the interest of this material, and through the labs work, which transforms it into a product that can be patented and traded.

It is obvious we are facing a case similar to the seed metamorphosis, as well as it is obvious the arguments of Moore's healers are similar to biotechnologists arguments. Marie-Angele Hermitte outlines precisely this similitude, She writes: "This way of thinking is well known. It is literally what was argued to deny any value to oil, it is literally what was argued to deny any value to the genetic heritage of wild plants! The oil hidden in the rocks is valueless; it acquires potential value through the knowledge of geologists, and effective value through the operation of exploitation and production. The wild plant, lost in nature, is valueless; it acquires potential value through the intuition of the botanist who is prospecting, and effective value through the selector's work, which transfers the interesting genes to cultivated plants. Suddenly, and roughly, instead of underdeveloped countries claiming on "the permanent sovereignty over natural resources", there are patients claiming on control over the products of their bodies."

Recognizing the patient's right to own his cells and genes, the American judge recognized, by the same token, that everything can be a source of profit. The obvious consequence is the opening of a market for body's products, a market for organs.

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We have seen the emergence of the biodiversity issue in the 80s was linked to tropical deforestation, and particularly to the Brazilian Amazon deforestation; secondly, we have seen the search for advantages which could justify the efforts to preserve rainforests, but also the difficulty to assign a value to them as "natural capital"; then we tried to show how biotechnology and the new materials revolution appeared as high technologies which could overthrow the boundaries between technology and nature and between the mechanical and the organic. Biotechnology became the promise of a new connection between environmental and economic values. But the seed metamorphosis and the possibility of patenting living beings indicated this high technology converts environmental value into economic value by transforming biodiversity into raw material. Now we can try to examine how Brazil has been dealing with this complex issue, which is simultaneously a global and a national question; and we can try to verify if Brazilians accept the conversion of the diversity of life-forms into raw material.

The biodiversity issue means a challenge Brazil is summoned to answer, and it seems the evolution of planetary environmental crisis transformed the Amazon forests into a crucial problem... or a crucial opportunity for Brazilians. Through the biodiversity issue will be tested

the political will of the industrialized countries of the North to overcome the environmental deadlock and to review the trend of their unsustainable development; but on the other hand through the biodiversity issue will be tested Brazil's capability to secure the recognition of the value of its natural resources, not only for this country but for all countries. Everything seems to depend upon the transformation or not of these resources into raw material.

Brazilian people do not know the country has now a role to play in international relations, due to the environmental global crisis and to its position as the most important megadiversity nation. Brazilian people do not even believe the country could have a voice in international affairs. And this misunderstanding is dramatically evident in Brazilian elite.

In Brazil the environmental issue used to be considered as a minor question by businessmen, by political parties and by the intelligentsia. That is why Brazilians were very surprised by the international impact of the murder of Chico Mendes or by international mobilization to help the Yanomami people; that is why Brazilian media always portrayed Jose Lutzenberger as an eccentric character, or why Brazilian congressmen figured the United Nations conference in Rio was an ecological circus. Brazilian elite still thinks the indians have too much land, that they are "the biggest landowners of the country". And attention was paid to deforestation only when international financing institutions like the World Bank refused new loans to environmental disasters in Amazonia.

The attitude of Brazilian elite could not be different, because the axis of devastation relies precisely in the manner Brazilians consider the natural resources of this country. All Brazilians would declare they love Brazil's natural wealth, but there is an abyss between rethorical celebration and the sharp reality of devastation. Brazilians have always been predatory. Long before environmentalists pay attention to predatory development, the historian Sergio Buarque de Holanda had pointed out the predatory feature of the civilization process in Brazil.

Sergio Buarque was the man who knew the techniques through which Brazilians were related to the territory, he knew how Brazilians behave. His first book, **Raizes do Brasil**, demonstrates why "we are uprooted in our own land", why we behave like conquerors in search of easy wealth, why we want to get the maximum with the minimum effort and as quickly as possible. With Sergio Buarque we learned that agriculture in Brazil has always been an activity more likely to mining, if we consider the way it deals with the land.

The link between agriculture and mining manifests the impetus of grasping the fruit of the land and defines quite well the crude and disenchanting manner through which the Portuguese colonists exploited the country. In Brazil, to discover meant to possess - to mine in order to leave. As a result, since the XVIth century, Brazilian resources have always been submitted to foreign requirements. It should be noticed that the theme of predatory exploitation leads Sergio Buarque's historiography to converge to Caio Prado Jr's historiography, which had taken however a very different path. But both finally agree that Brazilian natural resources have always had their value established abroad, that foreign markets have always organized Brazilian economy and society.

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Four centuries of predatory relationship towards natural resources consolidated a pattern which was deepened by industrial techniques and capitalist modernization in the XXth century. Nevertheless, the continental dimension of the country preserved the Amazon forests, which remained almost untouched until the 1960s, when the military decided to integrate the region to the national development process. We have no time to discuss how was opened this last frontier. But it must be reminded that all the big projects - cattle ranchs, roads, mining, hydroelectric plants, settlement of colonists - had a strong environmental impact because they required deforestation or they made it much easier.

Many different forces were committed to predatory action and they brought into existence a network of multiple interests: international financing agencies, military and civil technocracy, regional and national elites, transnational corporations, logging companies, landless peasants, goldseekers took part in this process. Of course the predatory style of the Brazilian development was not circumscribed to the Amazonian forests. The social and environmental problems of other regions are also very serious, perhaps even more serious if we take into account the immediate needs of the whole Brazilian population; the environmental impact of the chaotic and accelerated growth of Brazilian cities due to rural and urban pauperization cannot be disregarded. Even though, to misconceive the importance of the Amazon environmental issue would be a tragic error. As it happens in other parts of the world, the environmental crisis in the South of Brazil does not have local, national and global dimensions. In contrast, all these dimensions propelled Brazilian Amazon rainforest to the centre of world ecological debate and explained why indians and rubber-tappers found, beyond their traditional defenders within Brazilian intellectual and scientific community, new allies in European and American non-governmental organizations, and good listeners at the highest international circles.

Amazonian deforestation became a central issue of world ecological debate, but also an international political problem, which was clearly distinguished by Andrew Hurrell, for whom the political problem does not emerge directly from the global impact of deforestation, but rather from the incongruence between the international legal and political boundaries of the state system and the boundaries of ecological causal networks. Once again was manifest the same concern caused by the nuclear accident of Tchernobyl, related to the transnational effects of an ecological disaster. Hurrell remarks that deforestation was taking place in forests wholly located in Brazil and that their preservation or destruction lies within the sovereign jurisdiction of the Brazilian state. "But this raises the important question as to whether and to what extent rainforests are in fact part of the "global commons" and represent a collective good." After careful analysis, he concludes forests are both a "global commons" providing a collective good from which all benefit and the "property" of an individual state.

Hurrell then draws our attention to the extremely difficult political and moral questions are raised if rainforests should be considered the common patrimony of mankind. He asks: "Precisely which resources should be so classified and who should decide on their definition and fate? What does a right of access to such resources mean? Should it be on the basis of a free market? If not, how and by whom should markets in forest resources be managed? To what extent do duties to conserve such resources legitimize outside political intervention?"

The mere formulation of such questions may freeze some Brazilian military officers, to whom the Amazon region is a matter of "national security", is "an strategic reservoir", and to whom the environmental and pro-indigenous movements are obstacles that undermine "the

permanent national objectives". Nevertheless, Hurrell questions are relevant because they express what really matters - the Amazonian rainforest resources.

It is extremely interesting to notice that the Brazilian political scientists did not grasp the importance of what was going on, and did not realize that deforestation had led to the internationalization of the Amazonian problem and had pushed Brazil towards the global political scene. The Brazilian political scientists could not see anything because they have always been unaware of the environmental problem and because the biodiversity issue is not yet a visible economic object of contention.

Analyzing the Brazilian response to the internationalization of the Amazon deforestation and to the external pressure that began to come over Brasilia, Andre Hurrell identifies two different phases: during the first phase, which lasted almost until the end of Sarney's government, the dominant response was a sort of negative reaction based on an outraged nationalism emphasizing the national security imperative and rejecting the new "ecological order" that the developed world was supposedly seeking to impose to the country. However, by the end of Sarney's government, but mainly under Collor's government Brazil moved away from hard-line environmental nationalism: the demarcation process of Yanomami land was engaged, there was a marked slowdown in the rate of deforestation and Brazilian international environmental policy changed significantly. According to Hurrell, awareness was growing among Brazilian leaders that the economic benefits of traditionally conceived Amazonian development were far more limited than the mythology suggested and that the country was failing to profit from some of the most important potential benefits - for example, the commercialization of the forest gene pool. In short: Brazilian politicians had decided to play the environmental game and had reviewed the nationalist conception of development. In this sense, Brazilian diplomats who were preparing the Rio Conference in 92 should be far away from the policy supported at Stockholm in 72.

It is difficult to disagree with Hurrell's analysis and to minimize the shift in Brazilian environmental policy from Sarney to Collor. Moreover, a disturbing continuity can be traced between Brazilian diplomatic positions in 72 and in 92. And perhaps this continuity should not be attached either to the authoritarian and nationalist model of development promoted in the 70s, nor to the sustained development model of the 90s. The continuity seems to manifest the obstinacy of Brazilian diplomacy concerning natural resources.

We could seize the constancy by tracking the evolution of Brazilian position back to the years that preceded the Stockholm Conference. In fact, at that time, Brazil was the first country to link environment and development, the first country to argue that natural resources of underdeveloped nations were affected by a process of depletion due to the intense exploitation required by the necessity of counterbalancing the fall of raw material prices in international markets. Brazil was the first country to question the rich industrialized nations whether they really wanted to connect environment with economics and politics.

In 1971, the year before the Stockholm Conference, the North-South dimension of the environment issue was clearly exposed in two different occasions. At Founex, in Switzerland, when Brazil succeeded to establish the link between environment and development as a key-question to be discussed in Stockholm; and at the XXVIth General Assembly of United Nations, when the industrialized countries proposed that the natural resources should be placed under the control of a World Trust, so that they could be shared by mankind. The

Brazilian delegation opposed forcefully the proposal, with the same argument developed later, at Stockholm, by Miguel Ozorio de Almeida. As the ambassador puts it, "United Nations action takes place within the framework of world divided into national states having a high degree of sovereignty over the resources within their borders. This is a fact of life that, until changed, must be kept in mind when dealing with problems relating to natural or any other resources. If this was not so, the still untapped natural resources of underdeveloped countries - very often their only assets and basis for development - would quite likely be placed by the Stockholm Conference within a world trust and thus at the disposal of the voracious industry and consumption of highly developed countries. Simultaneously the developed world, closely sheltered by its national boundaries, would keep basically unchanged its economic power, its industrial productivity, and its financial control of the international community. It should be understood that what is necessary is either one universal framework for all sectors, or a national framework for all sectors. If resources are shared in trust by all peoples, then economic power, industrial productivity, and financial control should also be shared. Since the latter is considered unthinkable by developed countries, the former should also be unthinkable by underdeveloped countries."

Twenty years later, Brazilian diplomatic position concerning natural resources remained unchanged. Introducing the technical studies dossier that supported Brazilian arguments for the Rio Conference, Roberto Pereira Guimaraes writes: "the (Latin-american) region possess the most significant natural and biogenetic resources required to ensure development. We hope (...) the same assumptions supported in 72 will influence again the discussion in 92."

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The Brazilian diplomatic purpose to defend, even before 72, the country's natural resources was comforted by the rising of the biodiversity issue. The diplomats were ware of what was happening in the North, and began to consider the Amazonian forests more as an opportunity than as a problem for Brazil's future. Therefore, they began to think the region should not be destroyed. Even if Brazilians do not know yet how to explore it, biodiversity became the most important patrimony. The Ministry of Foreign Affairs is conscious that this positive aspect of the Brazilian environmental issue is also responsible for the global dimension the question finally assumed. In fact, according to Vera Machado, it was precisely because Brazil was conscious of this new situation that the country proposed to host the Conference.

It should be noticed that Brazilian diplomacy may be approaching the national and international environmental movement. And maybe this sort of convergence occurs not only because diplomats think deforestation must be stopped, but also because the environmental movement itself has changed. It seems that meanwhile the Ministry of Foreign Affairs gradually understood that the predatory development of Amazonia compromises the biggest trump card of the country, the environmental movement of the North gradually understood that the global environmental crisis cannot be overcome through a North-South war, through a world divided into consumers and paupers. Brazilian diplomats grasped the meaning of technological change in the North; European and American environmentalists grasped the meaning of the downward spiral in the South. Diplomats began to support the end of

deforestation; environmentalists, to support the end of poverty and consumerism, and another model of development.

Such a change in European and American environmental movement is due to the alliance between NGOs of the North and the organizations of indians, rubber-tappers, poor communities, etc of the South, which were trying to defend their environment for vital and not for ideological reasons, or for selfish interests. The environmental movement of the North learned in the South that the planet cannot be saved unless by a daily struggle to save life, all forms of life, the diversity of life-forms.

The confluence of Brazilian diplomats and environmentalists became clear when they stressed their positions about the Biodiversity Convention, to be signed in Rio. Let us take, for instance, the point of view of David Cooper, who works for the ngo GRAIN - Genetic Resources Action Plan. Cooper remarks: "The convention is likely to be successful in addressing the problem of biodiversity loss only if it: guarantees access to genetic resources; provides remuneration to developing countries, including concrete support to farmers and other people's organizations directly involved in biodiversity conservation; contains an agreement on access to the new technologies."

If we exclude the explicit reference to the concrete support to farmers and people's organization, these three points are similar to those proposed by Brazilian diplomats.

Even before Rio-92, the disagreement between North and South was manifest concerning access to biodiversity. The industrialized countries defended the free access to germplasm banks, arguing that biodiversity is the common patrimony of mankind; Brazil, of course, defended access ruled by each country, which has sovereign rights over natural resources existing in its territory. Twenty years later, ambassador Almeida's words were still valid: if genetic resources were common patrimony of mankind, then the fruits depending on genetic existence and transformation should also be common heritage. In a few words: the access to biodiversity resources should correspond to the transfer of biotechnology and all sorts of technology helping preservation.

The link between biotechnology and biodiversity was thus explicit. For the industrialized countries it is vital that access to genetic resources is guaranteed; in contrast, for Brazil, it is vital that access to biotechnology is guaranteed. And that is why the patent and intellectual property issue became instantly crucial. Everyone knows Brazil's diplomatic success in Rio, when only the United States refused to sign the Biodiversity Convention, claiming precisely their commitment to the patent system. But at the same time, it must be said that Brazilian foreign policy success was immediately put in serious danger.

The political situation in Brazil is such that the same President who signed the Biodiversity Convention, so tenaciously defended by diplomats, sent to the Congress, the day after the Conference's closure, a new version of a bill ruling industrial property, and namely patents. The Bill 824/91 simply allowed the industrialized countries and transnational corporations free and unconditional access to Brazilian biodiversity! Many articles of the text contradicted the article 1st of Biodiversity Convention, which recommends a fair distribution of the benefits related to the using of genetic resources. The text had been conceived to grant the right of exclusive ownership upon living beings created artificially and ignored all about micro-organisms. It seems the bill, proposed by the Presidency, had been inspired, and

perhaps even written, by Interfarma, an association of European and American laboratories which main objective was the promotion of the patent system in Brazil.

The impeachment crisis postponed the vote of the bill by Congress, and the future of Brazilian biodiversity is still open. Now the biodiversity and the patent issues are in the hands of the new government. In his inauguration, President Itamar Franco had some words for biodiversity: "(...) considering the wealth of our biodiversity and the work that had been done, I am particularly hopeful the biological sector will give us a strong position in the world."

Meanwhile, biotechnology proceeds with the work of converting life-forms in raw material. In the middle of the 80s, an awful market appeared in Brazil when desperate people began to sell a kidney or an eye through the newspapers ads. Nowadays the biomarket expanded and entered the North-South relations. The 26th January 1993, Professor Leon Schwartzberg, French Euro-MP and cancer and Aids specialist, said binding European Community rules on transplant were necessary to prevent Third World paupers from being lured into selling parts of their bodies.

Children in developing countries have been mutilated and murdered so that their organs can be sold for transplants in the West, told the MP to his colleagues. "Organized trafficking in organs exists in the same way as in illegal drugs and it is often controlled by the same people."

There is a trade in babies from Central to North America, ostensibly for adoption, while in reality they are killed for organs such as their eyes. And Prof. Schwartzberg concluded: "There is a big trade in organs between Brazil and Germany."

Thank you very much for your attention.

The Latin American Centre  
Saint Antony's College  
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