Apocalypse... Now? Molecular epidemiology, predictive genetic tests, and social communication of genetic contents

Apocalipse... Agora? Epidemiologia molecular, testagens gênicas preditivas, comunicação social de conteúdos genéticos

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Abstract *The author analyzes the underlying theoretical aspects in the construction of the molecular watershed of epidemiology and the concept of genetic risk, focusing on issues raised by contemporary reality: new technologies, globalization, proliferation of communications strategies, and the dilution of identity matrices. He discusses problems pertaining to the establishment of such new interdisciplinary fields as molecular epidemiology and molecular genetics. Finally, he analyzes the repercussions of the social communication of genetic content, especially as related to predictive genetic tests and cloning of animals, based on triumphal, deterministic metaphors sustaining beliefs relating to the existence and supremacy of concepts such as 'purity', 'essence', and 'unification' of rational, integrated 'I's/egos'.*

Key words *Risk; Molecular Epidemiology; Medical Genetics; Genetic Techniques*

Resumo *Abordam-se aspectos teóricos subjacentes à construção da vertente molecular da epidemiologia e do conceito de risco genético, tendo como referência as questões postas pela atualidade: novas tecnologias, globalização, proliferação de estratégias comunicacionais, diluição de matrizes identitárias. São discutidos problemas relacionados à constituição de novos campos interdisciplinares, tais como os da epidemiologia e da genética moleculares. Ao final, desenvolve-se uma análise das repercussões na comunicação social de conteúdos genéticos, especialmente referidos a testagens genéticas preditivas e à clonagem de animais, a partir de metáforas triunfalistas, deterministas e sustentadoras de crenças relativas à existência e supremacia de conceitos como pureza, essência e unificação de eus/egos racionais e integrados.*

Palavras-chave *Risco; Epidemiologia Molecular; Genética Médica; Técnicas Genéticas*

"*Disease Control: A proliferation of imaginary diseases may soon be expected, satisfying our need for a corrupt version of ourselves; Epidemiology: Catastrophe theory in slow motion.*" James Graham Ballard.

Introduction?

The above quote is by one of the most acclaimed authors from what is classified as the 'science fiction' genre (although he has also produced non-scientific stories): J. G. Ballard. It is one of the entries from his *Project for a glossary of the Twentieth Century* (Ballard, 1992), resulting from his editor having presented him with a series of topics on which to develop ideas and free associations. Here, the 'catastrophe theory' of epidemiology does not appear to be dealing with the mathematical approach to discontinuities as proposed by Thom (1985), but to the usual notion of 'disastrous'. Proceeding with this line of interpretation, we presume modern epidemiology to be that of Ballard's reference, i.e., one of the disciplines responsible for the description and analysis of multiple risk factors hovering menacingly over all of us in the daily life of contemporary societies. 'Slow motion' suggests a non-immediate interval of chronological time between exposure to the numerous risk factors and the presumed dire fate...

The concept of risk can be demarcated within a semiotic operation by which to better understand its spin-offs (Figure 1). Based on Samaja (1997), let us consider the various terms Tn, where:

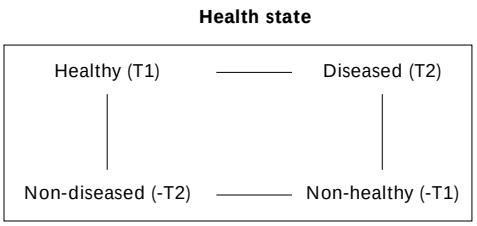
a) the relationship between T1 and T2 is that of 'contrariness';

b) the relationships between T1 and -T1 and T2 and -T2 are those of 'contradiction'.

The non-healthy state itself could coexist with that of non-diseased (for the time being...), but due to the virtuality of risk (i.e., the possibility that the respective disease will materialize at any moment), the fact that one is in a situation of health-at-risk means being the carrier of a weakness that demands the adoption of protective/preventive measures. A spin-off of this chart is to conceive of an 'epidemic' of pre-diseases, represented by the various non-healthy individuals, or ones who are healthy, but subject to one or more of the various possible risks.

Figure 1

Use of the 'semiotic square' to health state (Samaja, 1997:300).



This condition also has the dubious virtue of becoming a 'risk factor' per se by invading and affecting our imagination, becoming a stress factor that can lead to various forms of falling ill. Take a hypothetical example: individuals knowing that they have high cholesterol rates raise their level of 'anxiety/stress', thereby expanding their cardiovascular risk profile.

This scenario entails a new notion of hygiene (Vaz, 1997). The contemporary hygienist approach focuses primarily on controlling risk behaviors related to so-called lifestyles, i.e., ways of eating, drinking, having sexual relations, taking physical exercise, using or refraining from using drugs, dealing with daily stress and tragic life events, etc. However, it is not usually feasible, in the face of such a variety of risk factors (or temptations) to avoid all possible sources of exposure. Based on the circumstances, the risks may become possible ways of dealing with life's demands.

In other words, it is important to distinguish the elements shaping the epidemics of wishes – or desires – (Sedgwick, 1992), since the borders are not clear between 'addictive' (abnormal/sick) states and 'non-addictive' (normal/healthy) ones, to the point of our reaching apparently paradoxical situations: individuals that are 'dependent' on substances and compulsive (yet supposedly) healthy behaviors, including strict diets with no evidence of actual need, indiscriminate popping of vitamins, abusive physical exercise, etc. In contemporary Western societies, centered on the concept of a core cognitive-volitive identity (called I/ego), it is difficult to escape from the 'corrupt version of ourselves'. No matter how much willpower one (egoistically) hopes to have (in fact, the strength to dominate the involuntary/unconscious), the more the latter insists on cropping up...

Modern Anglo-Saxon epidemiology is known for its tradition of avoiding critical stances towards the discipline's own failure to demarcate the importance of psychological, social, economic, cultural, historical, and political factors (amongst others) in the genesis and develop-

ment of disease processes. Still, researchers from this watershed have increasingly recognized signs of strain in risk-factor epidemiology and the need for other ways of approaching epidemiology (Krieger, 1994; Pearce, 1996; Susser & Susser, 1996a, 1996b; Shy, 1997). This appears to constitute a tardy recognition of issues raised since the mid-1970s by the Marxist epidemiological watershed, improperly called 'social epidemiology' (we will get back to this). One might well ask if it was necessary for the centralized economies to fall in order for epidemiologists from the so-called advanced capitalist countries to allow themselves to discuss the relevance of socioeconomic factors in the individual and collective disease process without running the risk of defending what might have been branded as communist ideas...

At any rate, along with some undeniable gains in health-related knowledge (with special emphasis on the emblematic studies on smoking and lung cancer), one could briefly ascribe a series of side effects to 'risk-ologic' epidemiology: "*biophysiologic reductionism, absorption by biomedicine, a lack of real theory about disease causation, dichotomous thinking about disease (everyone is either healthy or sick), a maze of risk factors, confusion of observational associations with causality, dogmatism about which study designs are acceptable, and excessive repetition of studies. (...) [T]his approach diverts limited resources, blames the victim, produces a lifestyle approach to social policy, decontextualizes risk behaviors, seldom assesses the relative contribution of nonmodifiable genetic factors and modifiable social and behavioral factors, and produces interventions that can be harmful. These trends are particularly noticeable in the recent rise of molecular epidemiology, especially in the renewed emphasis on issues of individual susceptibility*" (Pearce, 1996:679).

Some of these topics will be developed further over the course of this paper. For the time being let us turn back to Ballard. Known for his cataclysmic inclinations towards the trials and tribulations of Western societies, this facet crops up in various parts of Ballard's work, especially in the book *Crash!* (the basis for the film by the same name) first released in English in 1973. In his introduction to the French edition (published in 1974), Ballard indicates the initial manifestations of the effects of technosciences on contemporary social relations, the regime of which has been further consolidate since the book came out (Ballard, 1988).

We simultaneously have new technologies and their corresponding repercussions: in the expansion and velocity of circulation of economic exchanges (globalization), in the proliferation of communications strategies, in the crisis of meaning, in the multiplication and dilution of identity matrices, in the widespread climate of ambiguity as to individuals' prospects for orienting themselves in the short term.

Amaral (1996) calls this time 'actuality', using the metaphor of the maze or labyrinth to represent it. We live under the aegis of Paradox, "*beyond the classic dichotomies of opinion and truth, common sense and science, conscious and unconscious, illusion and reality*" (Amaral, 1996: 24). An oxymoronic culture, since according to this author its characteristics are the following: virtual consistency, an undifferentiated frame of reference, and truth in simulation (Amaral, 1996). In other words, there is less and less room for synthesis (in the Hegelian sense). It is necessary to coexist with different (and occasionally opposing) points of view, with no prospects for reaching a conclusive synthesis (Tsouyopoulos, 1994).

According to Ballard: "*the main 'fact' of the 20th century is the concept of unlimited possibility. This predicate of science and technology emphasizes the notion of a moratorium on the past the irrelevance and even the death of the past and the unlimited opportunities available for the present. (...) the future is also failing to exist, devoured by a present that is all voraciousness. We append the future to our own present, as simply one more alternative among the many open to us. The options multiply around us, we live in almost a childlike world in which any demand, any possibility, whether lifestyles, trips, sexual roles or identity can be met immediately*" (Ballard, 1988:6-8; retranslated from Portuguese – translator's note) (A proviso to the above: as long as one has the buying power to consummate such demands...).

Symptomatically, the roles reserved for reality and fiction have been turned around. "(...) *We live in a world governed by fictions of all sorts: mass merchandising, advertising, politics conducted as a branch of advertising, the instantaneous translation of science and technology into popular images, the growing mixture and interpenetration of identities in the realm of consumer goods, television's appropriation of any free or original imaginative response to experience. Our life is one big soap opera* (...)" (Ballard, 1988:8; retranslated from Portuguese – t.n.).

Whether we agree partially or totally with the author or not, is it possible to avoid a Ballardian perspective as we witness the public spectacle that is made of the results and find-

ings of research in biochemistry (in DNA manipulation), in genetics (at the individual level), in molecular epidemiology (at the population level)? This is a difficult question to answer. Indeed, ambiguity marks the many issues raised by continuous biotechnological advances. Numerous situations arise in which scientific progress has two sides, advantages and disadvantages. For example, knowledge from the Human Genome Project will foster both prevention and segregation, new reproductive techniques provide possibilities for solving infertility problems, but they also raise new and difficult legal and moral issues (Lolas, 1997).

Yet never before has humankind experienced a situation like that of today. Due to the paroxysmal dissemination of biotechnological content by the mass communications media, the so-called lay public watches fascinated and bewildered the proliferation and juxtaposition of 'factual' news reports and literary, cinematographic, and televised stories focusing on molecular biology. For example: paternity investigation, predictive genetic tests for chronic, non-infectious diseases, in vitro fertilization, and cloning of human beings have become themes for the 'fiction' plots presented by the leisure and entertainment industry.

Now comes the time to explain the bombastic tone of the title. The term 'apocalypse' stems from the Greek *apokalupsis*, meaning revelation, unveiling, discovery. Nothing could be more suggestive of the possibilities created by the technobiosciences, especially by genetic manipulation techniques, in the quest for competencies allowing the human body to overcome its corresponding biological limitations, through the reprogramming of the very statute of the human species (Schramm, 1996).

This point of view transmits an image of two sides, combining both the need and *fear* of unveiling our deepest genomic truths, since for this to occur we must manipulate domains heretofore viewed as alien to our worldly desires and pertaining to the divine designs of heredity and procreation.

Along this line of reasoning, 'apocalypse' pertains to events and predictions from the past that are reviewed on the basis of present facts and their final consummation. In this sense, from an epidemiological reading, our probabilities of falling ill, based on exposure patterns and attributes constructed through risk-factor epidemiology and without unveiling causal mechanisms, appears to be approaching a discovery of new elements in causal networks through an expansion of genetic knowledge. But as we shall see, the magnitude of the 'revelation' should be viewed in with a grain of salt.

It should be clear that this paper is not intended to develop proposals to either appease or terrify potential readers. I believe that we are already experiencing them in our daily routines, with the current dizzying state of techno-scientific changes, with complex and difficult-to-assess psychological and sociocultural repercussions.

Our goal is to find some degree of intelligibility in the current situation by interpreting fragmented elements and indicators, assuming the risks of errors in the analytical proposals focusing on such an intricate situation. All of the items to be analyzed in the article can be challenged in terms of their respective statutes or degrees of pertinence. That is, discussions raised by the topics herein may also be viewed as irrelevant by some, who may feel that such fields are not even sufficiently well-defined to merit their own specific analyses.

There is no consensus as to the emergence of new disciplines or watersheds involved in the use of adjectives to describe this situation. According a view which I consider struthiform (i.e., ostrich-like), there is no 'new genetics' or 'molecular epidemiology' at all, nor are the issues of the public's understanding of genetic contents pertinent to the scientific domain. At any rate, such positions serve as signs of the lack of understanding within and amongst the various fields involved.

Regardless of the issues pertaining to territorial demarcations and schemes of hierarchy and dominance in research undertakings, what we have on the (dis)order of the day in the mass communications media is the reverberation of various levels of society, publicizing techniques, ideas, and production of value judgments related to genetic manipulation, the Human Genome Project, in vitro fertilization, embryo implantation, predictive genetic testing, discussions of bioethical consequences, the role of scientific journalism, etc. All this per se both authorizes the current paper and justifies the fact that we do not intend to get entangled in inconclusive debates on the disciplinary statutes of the respective fields. Even so, a few comments are needed on the baptism of new disciplines, since they go beyond the mere choice of labels.

Molecular epidemiology, with or without quotation marks?

How does one define molecular epidemiology? Simply speaking, it consists of the use of molecular biological measurements and markers in epidemiological investigation. That is, it studies the relationships between exposure and disease in populations, using methodological techniques proper to epidemiology. The necessary quantification and measurement are based on modern molecular biological laboratory techniques, aimed at: a) direct detection of changes in molecular structures (both in harmful agents and individuals susceptible to disease) b) indirect detection using immunological techniques to establish the existence of specific molecules from given products determined by gene activities. The origin of the term dates to cancer epidemiology studies using molecular biochemical techniques in the 1980s (McMichael, 1995).

It also serves to: 1) delineate the gradient of events between exposure and disease: internal dose, biologically effective dose, early biological effect, altered function/structure, clinical disease, and prognostic significance; 2) identify exposures to lower or older exposures to presumed harmful agents; 3) reduce classification errors in exposure and disease variables; 4) indicate mechanisms; 5) identify the role of exposure to given factors in individual susceptibility and response variability; and 6) expand the verification of risk levels in individual and group terms (Schulte & Perera, 1993).

Even so, the current state of the molecular art allows us to observe how exposure to presumed external carcinogens leads to mutations in the DNA of receptor tissues (adducts). This does not necessarily mean establishing causal links, since elements are still missing at the individual level to sustain the relationship between such molecular alterations and cancer genesis (McMichael, 1995). In other words, even with vigorous evidence to sustain the role of determination played by given biomarkers in carcinogenesis, exceptions to associations reviewed as causal are not unconditionally eliminated (Vineis & Porta, 1996).

There is even a 'molecular' watershed within the epidemiology of infectious/contagious diseases, the principles of which are worth analyzing. Bacterial genes coding for molecules performing activities in the basic maintenance of the microorganism's structure/function did not undergo any major changes over the course of evolution. On the other hand, other genes undergo strong selective pressure, such as those coding for cell membrane proteins. Based on the common origin of the medically relevant bacteria, one can construct the respective evolutionary trees based on analysis of the genes coding for these constant macromolecules (McDade & Anderson, 1996).

Gene 16s of ribosomal RNA has proven useful in this regard and is metaphorically considered a 'molecular clock' in the sense that it indicates the evolutionary distancing between two bacteria over time, i.e., in phylogenetic analysis. Using the polymerase chain reaction (PCR), the linear genomic sequencing of the constituent nucleotides of the 16s rRNA gene is determined for given species and is compared with that of other species, stored in *ad hoc* databases. Thus, previously described bacterial species are identified by genomic sequencing, and new species can be phylogenetically positioned by detecting the species-specific variable regions of the 16s rRNA gene.

Analysis of the sequencing of other variable genes specific to bacterial groups is used for typing strains and identifying differences between such bacteria. Although it is impossible to construct an evolutionary tree for all viruses, since there are no conserved molecules as in bacteria, there are conserved and variable genes that allow for the identification of relations within the groups (McDade & Anderson, 1996).

Such procedures serve to: 1) study outbreaks of diseases of unknown origin (e.g., hantavirus, a respiratory disease with a high case fatality); 2) detection and identification of bacteria resistant to culturing (e.g., Whipple's disease, a systemic disease involving arthralgia, abdominal pain, diarrhea, malabsorption, and wasting); 3) establishing unusual modes of transmission of diseases (e.g., AIDS and HIV-positive dentists); 4) verification of long incubation periods in rabies infection – a bite occurring in an immigrant in his country of origin more than six years previously; 5) paleomicrobiology – geographic identification of the origin of retrovirus strains, as for HIV, HTLV-I- (McDade & Anderson, 1996).

The controversies over whether there is a well-defined 'molecular' specialty in epidemiological domains can be summed up in three positions. There are researchers who categorically reject the possibility, considering it a series of developments proper to an existing watershed, that of genetic epidemiology (see the comments of Moreno & Rothhammer to the paper by Castiel – Castiel, 1994). Others cautiously prefer to use the expression in quotes, thus indicating the lack of consensus as to its actual *existence* as a sub-discipline, as the supposed

ambiguity of the designation (McMichael, 1995, Vineis & Porta, 1996) (we will return to this later). Still others sustain a *molecular* legitimacy and specificity in epidemiology, to the point of proposing its principles and practices, the sub-title of a compendium appropriately entitled *Molecular Epidemiology* (without quotes) (Schulte & Perera, 1993) and also in the studies of infectious/contagious diseases (McDade & Anderson, 1996).

Of course there are components extraneous to science in such quarrels, amongst which the struggles for prestige, especially as related to competition over research funds by various research groups. Their respective objects of research are always more 'relevant' than those of other groups and thus more worthy of the resources. Yet it is necessary to produce a rhetoric whose arguments are not presented as such, i.e., which is based on technical and scientific reasons. Taking the dissent into account, I believe it is worthwhile to approach the academic elements of these debates, since they allow us to clarify aspects pertaining to the focal issues.

Why is it difficult to 'molecularize' epidemiology?

There is discussion under way over whether the use of molecular biomarkers as a technique for data detection/collection is sufficient to define and designate a sub-specialty. McMichael argues that "*anthropometric epidemiology, of questionnaires on occupational antecedents*" does not exist. There is no disagreement on this point. But he adds that "*it is appropriate to sub-classify epidemiology by fields of investigation of a given defined content: clinical, genetic, environmental, and social epidemiology*" (McMichael, 1995:247).

This brings up issues involved in demarcating sub-disciplinary boundaries and the possibility of interpenetration of the various areas. For example, the 'genetic' watershed may occasionally overlap with the 'clinical' one. Further, how is it possible to clearly distinguish the 'social' from the 'environmental' field of investigation? We know that 'environmental' generally refers to the effects of exposure to pollutants on health, i.e., a toxicological epidemiology. But it is unsatisfactory to cut the 'environmental field' apart from the 'social field' and ascribe specific separate identities to them. Strictly speaking, the latter encompasses the former. Likewise, there are overlapping areas: exposure to environmental pollutants can cause genetic diseases. After all, despite McMichael's contention, the contents of these research fields display gray areas.

Indeed, nouns and adjectives are born and prosper (or wither) regardless of their corresponding current epistemological and theoretical relevance. For example, in chemistry, the loss of the original, indivisible etymological meaning of the term 'atom' has not meant that humankind has stopped using the word. In collective health, with the terms 'epidemiology' and 'social', the noun has long since surpassed the original meaning of the study of the infectious/contagious diseases that affect people from a given country. The adjective, characterizing the Latin American Marxist watershed of health studies in populations (emphasizing social inequalities in the class structure of peripheral capitalist societies as a fundamental element in the disease process, as opposed to the naturalized etiologic determination of 'classical' Anglo-Saxon epidemiology) is inadequate, since it is impossible to study in a 'non-social' way any human population, which is by necessity socially structured... Thus, epidemiological approaches must take so-called social issues into account, even when such notions may be fluid and dependent on theories that conceptualize so-called social reality.

In our opinion, based on recombinant DNA techniques or genetic manipulation, it is possible to conceive of both a new genetics and a molecular epidemiology, even if both areas result from technical advances deriving from other established fields. Running the risk of over-simplification, the issue is the interpretation of the magnitude and concomitant consequences of technological, methodological, and operational increments in given research sectors, to the point of generating the possibility of opening multiple promising research fields within others.

One way this can happen is by transporting internal achievements from given fields to other disciplines. This was how molecular biology emerged, based on the discoveries of physicists in the 1950s, with experiments using X-ray diffraction through crystallized DNA, leading to the theoretical postulation of the 'double helix' (Atlan, 1986).

Would it have been possible at that time to distinguish the origins of a field that decades later would come to produce DNA manipulations and cloning techniques? While the speed of technological changes and advances in knowledge is much greater today than then, I believe that, *mutatis mutandis*, similar effects may be applicable to molecular manipulation techniques (highlighting the polymerase chain

reaction and production of monoclonal antibodies) and bioinformatic modeling.

Of course one could argue that molecular biology remains a form of biochemistry (Izquierdo, 1996, oral communication), which in turn is a form of chemistry. Further, at the limit, the latter can be expressed in terms of the general laws of physics. We thus find ourselves slipping inexorably down the slope of heavy reductionist reasoning, leading to the inevitable 'finishing line', where all our scientific explanations end up at the physical/chemical limit.

However, there is a way to avoid this attractor-pathway. Consider the existence of a level of biological complexity in which the organization of a living being is also governed by laws beyond the realm of explanations based exclusively on current physical theories (which in turn lack consensus as to the limits of their validity): biological laws refer to historical/evolutionary events, out of equilibrium, occurring within a narrow range of temperature, pressure, and chemical composition (Edelman, 1992).

In fact, all this discussion ends up eluding the crux of the problem: the fact that epidemiology as a discipline tends to be defined primarily as a function of it(s) method(s), since it lacks consistent theories concerning its object: how populations fall ill. As pointed out by Mendes-Gonçalves (1992) the central theoretical issue of epidemiology is still that of acquiring consistency as a theory. According to Krieger & Zierler (1996), the theoretical contexts in the field are three: 1) epidemiological theories, formulating questions on etiology; 2) causal theories, constituting the basis for mathematical modeling to explain disease causation; and 3) theories on error, orienting research design, analysis, and interpretation of findings.

Examples of etiologic theories in epidemiology as quoted by the above-mentioned authors are "*biomedical, lifestyle, cultural, behavioral, and social production of disease*" (Krieger & Zierler, 1996:107). They proceed to seek explanations for the distribution of HIV/AIDS in populations and present two different theoretical pathways for this purpose: 'social production' and 'lifestyle', emphasizing the importance of the theoretical framework in defining research ideas, generating hypotheses, and producing knowledge.

Still, each disease entity should possess a mix of specified explanatory elements that appear in a unique way for each case (which is a case), based on the characteristics proper to the elements (infectivity, pathogenicity, virulence, and immunogenic potential) in their 'agent/host/context' interactions which are in some way peculiar to them. There are reasons leading to disease (or to cure) that can be generalized, but in a joint sense there are aspects unique to both groups and individuals.

Examples: a) in a socioeconomic/cultural formation where blood transfusions are morally condemned, bloodborne contagion, proper to given diseases, should not be expected to have the same relevance as in situations where there is what we might call a blood 'trade' and b) there are individuals who respond better than others to the treatment of psychosis with clozapine.

It is possible for 'biology' to be 'molecular', since its theory is based on molecular postulates concerning the structure of the DNA double helix and its role in protein synthesis. For epidemiology to be 'molecular', an uncomfortable estrangement emerges, since its own theories per se fail to sustain such a combination. Why not? I believe that one of the peculiarities of the 'epidemiological object' is manifested here: the fact that it is both biological and social. The noun refers to the collective level (of persons), while the adjective refers to the microscopic level (of biochemical reactions)...

Thus, adjectiving epidemiology tends to reflect the objects of other disciplines, mainly from biomedicine: clinical medicine, psychiatry, genetics, chronic diseases (cardiovascular, cerebrovascular, cancer), infectious diseases, mother-child, etc., or those pertaining to either the (environmental) field of biology/ecology or to broader, transdisciplinary concepts, like 'violence'.

What qualifies a discipline according to its own methods for investigating disease in populations is conditioned by categories circumscribing the respective object of study. These can be cut across by another, usually biomedical (sub)discipline pertaining to the individual level, or are designated in a broader way, giving rise to different forms of interpretation (environmental, social, etc...).

At any rate, we agree in principle with McMichael when he contends that "*we should take a critical view in incorporating new molecular biological determinations into the present current of epidemiological investigation, thereby expanding its reach. Good science will come from a synthesis going beyond the limits of the various disciplines and techniques*" (McMichael, 1995:251), as long as the understanding of the 'goodness' of science is viewed as something that produces relief of the inherent suffering of the human experience, as represented by disease or early death.

'Genomics': a 'new' genetics?

With advances in molecular biological techniques in general and genetic manipulation in particular, the field of health knowledge has undergone profound changes. Some have even postulated the emergence of a new human genetics, which can be defined as "*a body of knowledge and procedures based on recombinant DNA technology which creates information about the genes carried by individuals and their families*" (Richards, 1993:568).

It would certainly not be appropriate to get into a discussion over the pertinence of the adjective 'new' to qualify genetics. As in the case of molecular epidemiology, some authors studying the corresponding social dimensions from this area use the expression with quotation marks (MacIntyre, 1995), while others do not (Richards, 1993). In the face of recent developments in this field, encompassed under the term 'genomics' (Cohen, 1997a), this discussion runs the risk of splitting hairs, since:

1) from an ethical point of view, consecrated concepts like life and its inviolable value, reproduction, birth, and body have been dismantled by biotechnology (Santos, 1997). When mammals can be (re)produced artificially, the virtual cloning of *Homo sapiens* raises many complex problems, not only ethical but also psychological and social. The idea and implementation of cloning reflect recurrent myths that fascinate and frighten, encrusted in human fantasy and present in symbolic productions, like those relating to such primordial themes as creator/creature, origin/destiny, mortality/eternity, and identity/difference (Schramm, 1999).

2) from the contemporary biological perspective, the object of the discipline is not life *per se*, but the specific aspects relating to physical and chemical phenomena that could explain the functioning of living beings. In other words, the molecular biologist is concerned with the chemical processes occurring in given natural systems: animals and plants. Today's biochemistry is no longer concerned with defining life, but rather studying the chemistry of functional molecules (proteins), their interactions with each other and other substances, and the ways they participate in biological functions (Atlan & Bousquet, 1994).

3) from the viewpoint of market economics, a two-edged (inclusive/exclusive) operation occurs, which has led to: a) the creation of a terrain of biological research activities linked to private enterprise, with an inflow of resources never seen before – so-called 'big science' – (Sfez, 1996) and resulting advances in genetic knowledge and respective possibilities for intervention; b) the removal of the genetics 'monopoly' from the strictly academic sphere and the restriction of the latter's corresponding margin of activity, given the relentless economic competitiveness permeating the field, difficult for the academe to accompany.

Thus came the 'second wave' of North American biotechnology, including enterprises involved in sequencing DNA (identifying genes coding for proteins), their application, patenting, and regulation. This wave involves private biotechnology companies and their owners, managers, and researchers. These companies are devoted to activities like developing DNA probes, sequencing genomes of pathogens, identifying genes and their respective regulatory regions, selling subscriptions to access gene banks, producing and marketing genetic research kits, identifying genes for diseases with synergistic properties, and screening DNA samples from individuals and families affected by specific diseases (Cohen, 1997a).

As mentioned, the current situation particularly affects relations with the academic field. There are geneticists affiliated with such companies not only for reasons of personal gain but all due to the availability of large amounts of research funds, far superior to those of university institutions. Indeed, there is an underlying ambivalence in 'acadenomic' relations (a pun by the author quoted here). In addition to the cooperative side of such relations, aimed at complementing the weak points on the two sides of the equation, some researchers suggest that genomics companies are redefining research priorities (Cohen, 1997a).

The economic relevance of this undertaking can be appreciated by the various links between genomics companies and the pharmaceutical industry. This point merits comment. First, there are estimates that the drug companies are working on over four hundred potential pharmacological 'targets', i.e., enzymes, receptors, and ion channels (not belonging to pathogens) that play important roles in given diseases. A 'combinatory chemistry' is emerging that allows for the construction of huge catalogues of potential drugs through bioinformatic simulation techniques.

Second, new pharmacogenetic prospects are emerging for the creation of personalized drugs, i.e., the development of an understanding of the genetic roots of diseases, allowing for the discovery of their relationship to individual genotypical constitution. New sampling processes can thus be expected to emerge in clinical research, grouping cases and controls

according to genetically demarcated traits. It would thus be possible to standardize patients according to their capacity to respond to given drugs. For example, clozapine, a drug used to treat psychosis and having irregular and unpredictable effects from one patient to the next, might have its pharmacological activity checked on the basis of the presence or absence of mutant genes for dopaminergic receptors (Cohen, 1997a).

Yet there is controversy over the efficacy of this trend, which can be viewed as a fad, to the point of being labeled symptomatically as 'genomania' by Cohen (1997a). Knowledge of genes responsible for genetic diseases may not provide any benefit to patients in either the short or medium term. Take the example of the discovery of the genetic origins of sickle cell disease. To date, no cure has been produced as a result.

We should keep in mind that this a wager by entrepreneurs investing in sectors considered promising in terms of financial return. While it is evident and logical that technological developments from other technoscientific sectors (electro-electronics and information technology, for instance) are the objects of production and commercialization by private enterprise, the equivalent market logic cannot be transposed as naturally or without mediation to biotechnology as applied to humans. Crucial ethical issues arise, while relations heat up between nongovernmental organizations, public institutions, and private enterprise. Take the example of the troubled relations between nongovernmental organizations, companies, and government agencies in the purchase and distribution of modern drugs to treat AIDS.

There is also debate over the feasibility of preserving genetic endowments displaying high probabilities of helping decrease vulnerability to diseases, as in the discovery of genetic structures that impede the proliferation of HIV in the immune system. There are studies on the resistance of individuals with mutations in genes that code for CCR5 messenger receptors in the immune system called 'chemokines', where the primary HIV (prior to replicating in the new organism) binds to and subsequently penetrates into the host cells (Cohen, 1997b).

Another delicate point is the restricted access to DNA sequencing data for pathogens that can cost human lives. How can society regulate access to knowledge resulting from activities by biotechnology companies dealing with genomic findings as their own property? Serious issues like these keep cropping up in the technoscientific domain and demand constant review and action by governments, nongovernmental organizations, class associations, trade unions, universities, and all other interested parties. An example was the recent invitation to various sectors of Brazilian society to participate in drafting bioethical regulations for research involving human beings, in Ruling 196/96 of the Brazilian National Health Council (MS, 1997).

How can one measure the 'predictability' of genetic tests?

There is already discussion under way over a kind of predictive/prospective medicine. This can be attributed especially to the use of specific biomarkers aimed to provide predictive tests to identify carriers of defective genes, both dominant and recessive, considered responsible for chronic, non-infectious diseases. Strictly speaking, it is not really prediction, but rather affirmation based on the theories of probability. In other words, under these circumstances, the idea of prediction is usually not deterministic, as the term might suggest, but probabilistic (Castiel, 1996a). Even with progress in genetic testing, predictions (in the 'prophetic' sense) of medicine are only valid in the current state of the art for some specific diseases (like Down's syndrome and Duchenne's muscular dystrophy). 'Predictions' of risk based on currently available knowledge of the relations between susceptibility and disease for the majority of conditions assume a relevance *a posteriori*, after the disease has occurred. This would confirm the causal relations, even if one ignores the exact mechanisms involved in this process.

As we have seen, the amount of investments in the field of genomic research has expanded our knowledge of chromosomes, chromosomal regions, and gene loci that appear to participate in the pathogenesis of various diseases.

Nevertheless, there are diseases whose genetic configurations in molecular terms do not allow for a clear identification, as in the case of polygenic disorders (resulting from mutations in several different genes), or those in which socioenvironmental interactions play a role. Here, risk relations may not be perceived with the same satisfactory degrees of precision. Even so, numerous studies have attempted to establish nexus between attributes involving susceptibility/exposures/disease, regardless of the contingencies surrounding the predictability of the phenomena. An important example for pre-

vention is measurement of serum prostate specific antigen (PSA) as a coadjuvant in diagnostic screening for prostate cancer. However, several studies indicate that early detection and clinical/surgical intervention in elderly men do not alter survival rates (Kenen, 1996).

How, then, can uncertainties in risk assessment be decreased by increasing the tests' 'predictive' power? In some circumstances the answer may be unequivocally affirmative (detection of monogenetic recessive disorders *in utero* or screening for carriers of genes for specific hereditary diseases). But in the majority of cases, we must take into account that "*in many respects the identification of genetic bases for raised risk is simply a special case within the general field of screening for risk, but this may not be apparent to the lay public, nor indeed to many geneticists*" (Davison et al., 1994:344). This is especially true if we consider elements of imprecision arising from contingencies in dealing with polygenic disorders, variable expression of genetic material, unpredictability of the gene/environment relationship, imprecision still present in genetic testing through DNA markers (despite the high precision of the tests, one still falls back on probability to enunciate it), aspects of validity and quality control in population-based testing, and variable responses by susceptible individuals towards positive test results (Davison et al., 1994).

According to Lewontin (1992), the very conclusion of the Human Genome Project will not be totally enlightening in terms of providing information that can be generalized on causality:

1) Diseases belonging to the same diagnostic category may have varied origins. For example: the DNA of hemophiliacs differs from that of non-hemophiliacs in 208 different ways in the same gene.

2) It is quite difficult to know: a) the functions of different nucleotides in each gene, b) how the repercussions of specific situations can affect the way by which the cell dynamic interprets and translates the DNA, and c) how the constituent parts of a human being connect to produce an individual that functions as a totality, and further, with the notion of identity and reflexive consciousness.

3) There is a huge amount of 'polymorphism' in each genome. "*The final catalogue of* '*the*' *human DNA sequence will be a mosaic of some hypothetical average person corresponding to no one*" (Lewontin, 1992:68). Indeed, this is a phenomenon that also occurs in findings from epidemiological studies. Indicators obtained from most studies consist of mean rates resulting from studies performed in population groups. In the quest for information that can be generalized, one produces an abstract record of individuality, devoid of any reference to a particular individual.

How does one deal with the social repercussions of information on genetic content?

This theme, already discussed elsewhere (Castiel, 1996a), allows for at least three points of view, according to the 'agents' involved: emitters (scientists, researchers, or health professionals); transmitters (coverage of the biomedical/epidemiological field by the mass media, generally through the science editors of journals or specific scientific periodicals), and recipients (the so-called lay public).

With the publicity over cloning experiments in mammals, this interface has received great visibility worldwide. Simultaneously, the mass media *en masse* have focused ostensibly on the fact. Molecular biologists have appeared on television to answer doubts as to spiritual aspects, should 'creatures' belonging to the human species be generated. Further, they have played a particularly visible role in setting the population's collective mind to rest as to the impossibility of producing either another 'Christ' or 'anti-Christs', the latter symbolized by Hitler.

The question was foreshadowed in the collective imagination of the 1970s in a science fiction novel by Ira Levin in 1976 (that also became a film), curiously entitled *The Boys of Brazil*. As the plot unfolded, despite the multiple clones with the German tyrant's genotype and phenotype spread all over the world, nothing could guarantee that the Hitler 'psychotype' would be replicated in other spatial/temporal contexts. That is, the inborn versus acquired issue was at the lay public's fingertips.

And what about now, as we face the real possibility of cloning not just white sheep? What about dinosaurs, as in Spielberg's *Jurassic Park*, conceived by a physician, Dr. Michael Crichton? Or who knows, other hybrid chimeras, like those of the deranged Dr. Moreau, as H.G. Wells imagined? Such themes are dear to the realm of science fiction, but as Ballard has pointed out, they are escaping from the imaginary zoo...

The issue is emblematic of contemporaneity. According to Amaral (1996), the virtuality of artificial production of human beings become concrete through the ability to reconstruct humans based on the purification and correction of their raw material, DNA.

As highlighted by Sfez (1996), coexisting with the advanced and innovative concepts of molecular biology are the ancient traditions of alchemy. Alchemic processes are based on such notions as 'conjunction': the property of contrary and separate principles, elements, and essences to mix, like body and spirit, air, earth, fire, and water, hot and cold, wet and dry. In order to know 'nature', one must isolate and purify what is mixed, to then reconstitute it, correcting its imperfections. The notion of raw material, still prevailing in industrial chemistry, involves the same links. It consists of primordial, totipotent, and thus virtual matter, in the sense of possessing the virtue of becoming concrete and perfect in its attributes/properties/characteristics. Without going into details, it is important to highlight that concepts such as 'essence', 'raw material', and 'pure form' were developed by Aristotle in his theory of hylomorphism, where nothing exists as isolated matter and form. What is real is invariably made up of both. These are not absolute principles, rather relative to a hierarchy in which 'simple' forms of matter (like water, air, earth, and fire) are organized in various ways in terms of complexity to become minerals, vegetables, and animals (Samaja, 1997),

'Conjunction' and 'raw material' orient alchemy in its triple approach: a) to obtain the elixir of life, the philosophers' stone; b) to redeem and perfect nature; and c) to achieve total wisdom concerning the universe.

The elixir/stone would have: 1) the capacity to remove impurities from living bodies, so as to achieve the essence, allowing for immortality with health, thus avoiding decadence; 2) the property of transmutation, after the removal of base (defective, impure) metals from the noble, pure metal, i.e., gold.

Perfection of nature results from the application of the same ideas on a broader scale. The quest is to harmoniously reunify a nature which is manifested through contrary/mixed/disordered appearances. All knowledge is obtained through the operation of the purified and purifying spirit seeking the integration of all separate things in a single, ordered whole.

Implicit to such notions of purification of the body (which, to this end, must free itself of degenerative elements) are alchemic notions, rooted in the social imagination, like raw material, essence, extract, utmost, and active principle. Conjugated with the reality ascribed to the natural, deficient body is the constructed reality of an artificial, perfected body, able to overcome imperfections. According to Sfez: "*The virtual body is an 'extract', the result of a series of operations, a purer reality than the sensitive body that we generally see. Is this not an alchemic product taking the quintessence of its being from raw material?*" (Sfez, 1996:331).

Along this line of reasoning, another expression that merits attention is that of 'tare', from the Arabic *tarhah*, or what is rejected or subtracted from weighing a given merchandise, insofar as it is not part of the same (e.g., the recipient or vessel). Tare can also mean flaw or fault and by extension a physical or moral defect, to the point of total decadence, degeneration, or depravation, especially in the sense of perversion (Ferreira, 1975). Thus, impurity/imperfection is manifested in the form of a 'physical/moral defect' and, evidently, 'depravation' ('to deprave' also means to alter some thing or substance, like blood, in a harmful way), which can be genetically transmitted/inherited. If a *tarado* (or 'pervert' in Portuguese and Spanish) is one who commits a fault for reasons beyond his will, morals and proper manners are safeguarded. If there is guilt, it is in the genes (Gaillard, 1996).

This perspective is exacerbated by the so-called model of 'neurogenetic determinism', which mistakenly fuels expectations of identifying genes associated with deviant behaviors (like sexual practices considered aberrant, drug addictions, psychiatric disorders, and compulsive behaviors). This leads to an 'overvaluing' of biological factors (and the respective pharmacological interventions) to the detriment of sociocultural elements in the genesis of various forms of deviation and discontent in our civilization (Rose, 1997) – see the neuropathophysiological approach to bad mood, or, *dysthymia*, as publicized by the mass media.

Conclusion?

There is evidence of coincidences and similarities in the projects for deciphering and purifying the human genome and biotechnological programs targeting other living beings. Implicit in this are the goals of longevity with health, perfection of nature, and knowledge of all the latter's secrets. These points certainly underlie the fringes of interaction between the public at large, scientific journalism, and scientists.

Against this backdrop, situations arise that demand the population's genetic literacy (Richards, 1996). From this perspective, the public should be informed of the implications of genetic tests, especially the respective scientific validity and potential consequences of the results. At the limit, crucial decisions may be at

stake. One example already publicized by the lay press is whether women found to have genes linked to breast cancer and/or have a family history of breast cancer should submit to a 'preventive' mastectomy.

As we have seen, with the availability of genetic tests, many disease conditions become prone to so-called 'predictive' affirmations. But in fact, starting with the presence of genes that supposedly participate in the etiology, the risks of developing diseases display varying degrees of 'predictability'. In general, as we have seen, the risks (the probabilities of acquiring diseases) are only well-defined for a few nosological entities.

Despite the above, do people generally have sufficient genetic (Mendelian) knowledge to deal with such situations? Even with the mass dissemination of terms like DNA, gene, and chromosome, studies in England suggest that the answer is no (Richards, 1996).

One also needs some familiarity with basic notions of the theory of probabilities and its watersheds, or a kind of 'statistical literacy', which is rather unlikely to occur. Take the example of the fallacy of baseline rates in perceiving the occurrence of an event. In other words, the influence of the frequency of the event in the population on the results of predictive tests. For example, a test generates positive findings for a given factor 'F' for a given disease 'D', which affects one out of a thousand individuals, with a margin of error of 5% for false positives. A study observed that fewer than 20% of a group of biomedical personnel from the United States was able to correctly identify the chance of one in fifty of an individual acquiring disease 'D'. Or, if the question were posed differently, with no testing, in determining the expected percentage of diseased individuals there are indications that there would be a much smaller proportion of errors in the results (Matthews, 1997).

But a fundamental problem remains: the use of probabilistic thinking by human beings presupposes the existence of an integrated, central, and rationalizing 'I', evaluating and choosing the most 'reasonable' way to deal with life's vicissitudes. After all, this is subject to endless discussions over the nature of 'human nature' (with or without quotes...) and our understanding of the tension between reason and unreason in this particular biological species.

In our opinion, it is plausible to take the point of view that considers the cognitive processes linked to human consciousness dependent on unpredictable emerging configurations, originating from the competition/synergism of various neuronal groups in chaotic activity until the cortex reaches a widespread and transient electric state, thence eclosing a 'virtual self' (Varela, 1992) whose behavior, according to the respective experiential context, can be manifested in acts absolutely alien to the canons of 'rational rationality' (we will come back to this)...

With regard to the difficulty in understanding/grasping Mendelian contents, there are hypotheses suggesting: a) the use of inadequate, out-of-context teaching/learning procedures in transmitting them and/or b) the influence of psychological defense mechanisms against potential risks to one's self or family in receiving them (Richards, 1996).

One should also reflect on the effects of notions of kinship, ideas of heredity rooted in Western societies *vis-à-vis* the perception of genetic links among individuals from the same family. From the linguistic point of view, the very term 'inheritance' is impregnated with the legal connotation of transmission of goods and property from parents/relatives to their descendants. It is thereby possible to possess not only physical attributes, but also psychic traits and given disease patterns. According to this view, this represents a logic of joint correspondence of all such aspects so as to construct links between physiognomic specificities and disease processes. In other words, individuals tend to fall ill in the same way as the relatives to whom they are most 'similar'. Lay reports thus fail to link genotype with phenotype (Richards, 1996).

There are also indications of an imaginative level where there is a primordial substance (raw material!) which is inheritable and which, through undesirable 'mixtures', can lose its purity, defiling the individual's corresponding 'biological nobility'. This substance may sometimes be referred to as 'blood' (blood of my blood...), but this is not well-defined (Richards, 1996).

There is still a strong aristocratic notion (with alchemic roots) of the essence/purity of a lineage which should be preserved through 'breeding' with partners of the same "pedigree", so as to avoid a supposed degeneration, resulting from miscegenation with the rough, ignorant, and diseased plebeian world. This belief even appears to have gained strength with the risks of transfusion-borne contagion by known diseases and the fact that genetic tests involve blood samples.

In addition, there is a considerable dose of skepticism concerning the production of scientific truths and the real problem-solving capacity of expert biomedical systems, especially

those seen as having a predominantly technical thrust to the detriment of more empathetic therapeutic approaches. The spread and growth of 'holistically correct' practices is no coincidence. Despite existing difficulties, educational processes focusing on genetics/ethics should consider the lack of a harmonious and integrated 'I', the product of a 'written program' in our genes – as if genes unconditionally demarcated identity – (Nelkin & Lindee, 1995).

The ambiguity of the word/idea 'gene' can be understood, based on a reading of Haraway (1997), by the fact that technoscience is characterized by an implosion of categories (subject/object; nature/culture) and also because its processes are simultaneously material and semiotic. Side by side with technical processes there are, necessarily, tropes, or figures of speech. 'Gene' possesses two sides at once: literal and figurative. Indeed, a figure possesses both geometric and rhetorical aspects. 'To figure' refers to both graphic/visual and linguistic representation, participation in a history. All languages are made of tropes that organize our narratives and interpretations. The crucial question is who has the power to produce and disseminate given tropes (metaphors and metonymies) to the detriment of others, whereby we seek to give order to our worlds (Haraway, 1997).

After all, since apocalypse as revelation is not possible, apocalypse as disaster seems to creep into social constructions within the public imagination, at the level of appearances. Alongside biotechnical advances in general and biomedical ones in particular, underlying the manipulation of DNA are representations of frightening aspects, manifested in the public (and private) repercussions from publicizing contents pertaining to genetic manipulation.

Such repercussions have arisen amongst us with a symptomatically humorous format in daily conversations and the mass media, where jokes on cloning, genetic inheritance, and similar themes are increasingly common (Love, 1996) – take the film by Woody Allen, *Mighty Aphrodite*, from 1995, where a father discovers that the mother of his talented adopted son is a slow-thinking prostitute. According to Love, "*The humorous observation and the joke take off precisely because there is no one meaning we all agree to give the term 'the gene'. There is paradox and inconsistency in the information we are given. Learning to live with ambiguity is part of the process of getting to know your genes*" (Love, 1996:26).

Indeed, such situations apparently have trouble disguising a feeling of discomfort over 'one more' invention by scientists, where more and more 'sorcerers' apprentices', overlook the possible side effects of their 'discoveries'... Fiction, delirium, and scientific 'reality' become 'con-fused' with the 'possibility' of the spirits of Drs. Jekyll, Moreau, Frankenstein, and Goebbels 'incarnating' in some sophisticated underground biotechnological laboratory. Leaving aside such potential folklore, the possibility of something occurring beyond the realm of attempts to regulate cloning was proclaimed bombastically (and was generally not taken seriously by scientific circles) in early 1998 by an American researcher, Dr. Richard Seed.

At any rate, attention should be paid to signs of such a menacing atmosphere with unpredictable spin-offs. There has been an immediate frenzy of bills passed by various governments without evaluating the intricacies and facets of genetic research (Schramm, 1999) *vis-à-vis* the image of a threatening (?) sheep, previously a symbol strongly linked to Christianity as a meek animal, the lamb of God (Wisnik, 1997, oral communication), willing to be led by the shepherds, along with the rest of the herd, to eternal salvation.

Ever since animal cloning became possible in the 1950s, in experiments with batrachians, chimeras were no longer just mythical figures, the figments of human imagination, incongruities, fish or plants with genetically distinct tissues (Ferreira, 1975). Chimeras now begin to acquire the status of mammals, quite close to us humans.

Still, we should emphasize that cloning of mammals still involves serious difficulties. According to the technique used by the Scots scientists to generate Dolly, the introduction of the nucleus of a 'totipotent' somatic cell (not just any cell serves the purpose...) into an enucleated ovarian cell (oocyte) requires a process of 'malnutrition', starving the donor-cell DNA so as to impede replication during transfer. This produces distortions in the coding function of the nucleic acid. Another delicate question is promoting the fusion and activation of the donated DNA (by way of an electric current), without its original proteins, with the new cytoplasmic proteins from the oocyte, so as to assume a new 'programming'... There is a species-specific time interval for this to occur. In sheep, it occurs up to the eight-cell stage, while in rats it occurs during the two-cell stage (this may be one of the reasons that no one has succeeded in cloning rats thus far). In humans, DNA is activated in the four-cell stage (Pennisi & Williams, 1997).

Nevertheless, doubts have arisen concerning the innovative aspects of the Glasgow

Roslin Institute experiment. By about a year after the research was published, no replication of this type of cloning had been observed. Due to peculiarities in the process of creating Dolly, it is possible that this famous ewe originated from donor embryonic cells rather than a mammary cell. The female donor was pregnant and had died before the presumed cloning. Her cells were kept viable through artificial techniques involving freezing. There is no absolute certainty that embryonic cells were not used to generate Dolly, in which case there would be nothing new in the cloning process as it is known in the biotechnological field (Veja, 1998). Wilmut and his team counter-argue that the probability of error is minute and that there has still not been sufficient time to replicate the experiment (for greater detail on this controversy, see Schramm, 1999).

Regardless of whether the somatic cell origin of Dolly is confirmed, what calls our attention in this chain of events are the replicating possibilities: production of immunocompatible tissues for transplants and reproduction by sterile (or fertile...) individuals via artificial fertilization (Kahn, 1997). At any rate, two possible questions arise: a) Was there a blow to sexual reproduction? (by allowing for parthenogenetic processes that dispense with male gametes...); b) Was there some offense towards religious doctrines that postulate spirituality as divine creation accompanying the material human body?

We do not mean to dwell on such complex issues here. Yet one cannot help realizing that genetic manipulations and evolutionary concepts contradict myths and symbols of creation/origin from Western religions and spark natural reactions amongst their leaders.

Take the term 'hybrid', pertaining to the meeting of elements from various sources that are mixed, and whose Hellenic origins (*hubris*) point symptomatically to the meaning outrage. For the Greeks, miscegenation violated natural laws (Machado, 1956), a notion still in force today... And as we know, clones, paradoxically, result from a parthenogenetic process in which the mixture of components is capable of producing both the replication of living beings and the creation of transgenic and thus hybrid beings. Both violate fundamental Biblical canons which for humans (natural living beings resulting from the divine Genesis and endowed with spiritual dimensions) are now threatened by a potential Clonesis. Will it not be a matter of time before we witness the genetic genesis which will artificially generate beings produced in the image and semblance of beings already created?

From the point of view of divulging genetic contents, health professionals from the field of genetics should seek to orient the public directly and indirectly (via the 'mass media') in relation to realistic perspectives, compatible with the cloning 'state of the art'. Even more importantly, they should promote a demystification of the mistaken use of analogies and metaphors in the field of molecular biology as to the capacity for manipulation of recombinant DNA and mapping of the human genome involving: triumphal points of view, like the possibility of accessing the Holy Grail, the philsophers' stone, or elixirs for eternal life; deterministic perspectives, like a 'recipe', 'plan', or 'program' whose development is or will be predictable or controllable; those sustaining beliefs relating to the existence (and supremacy) of concepts like 'purity' or 'essence' (of blood, race, and the species), while holding 'miscegenation/mixing' to be outrageous, with tares and depravations transmitted by this genetic route. Such aspects point to the construction of a notion of genomic responsibility with serious consequences for the production of what Rabinow (1992) calls biosociality.

On the other hand, no matter how unlikely it may sound (in technoscientific terms) to produce replicas of persons, with their unique psychic identities, it is not absurd to imagine uncontrolled projects for the production of human clones (commissioned by eccentric millionaires...) making possible ancestral dreams of 'immortality'. One must be clear about the two sides of the coin flipped by molecular genetics: 1) the possibilities of improving human life and minimizing suffering; 2) the risks of these advances being restricted to a few and/or serving as a stimulus for the resurgence of programs to 'purify' the 'race', linked to eugenic designs. Even with all the warning calls that have been issued, one can still conceive of a 'genethnics' (if we can be forgiven for the play on words) as the basis for justifying infamous ideologies, generally associated with political proposals of a fascist bent.

The last world war and its ethnic 'reasons' are associated in similar fashion with the discriminating/purifying mythical image underlying the current (and real) capacity of molecular genetics to identify ethnicity (Castiel, 1996b) and its (presumed) purifying cloning potential. We are thus faced with other essential tasks: to denounce and dismantle the discursive devices that can sustain them and to propose others that serve emancipatory designs for the human condition.

We belong to a culture which given the weakening of belief systems, legitimization,

and matrices for producing and sustaining identities insists on representing them insistently but ineffectively, in an *ad nauseam* reiteration of aestheticizing in which the mass media play a vigorous role in potentiating the prevalence of imagination over reality, as indicated by Ballard (1988).

"*Aesthetics is the way a civilization abandoned by its ideals cultivates the pleasure of representing them*" (Lyotard, 1996:207). Such pleasure perverts/depraves itself, since it emphasizes "*acting out, making a spectacle, turning over to the media, simulation, hegemony of artifacts, widespread mimesis, hedonism, narcissism, self-reference, self-affection, self-construction, and others*" (Lyotard, 1996:208).

Yet this process has reached a point of no return. With the proliferation and confluence of these signs/symptoms, we have reached a stage in which we face the possibilities of turning chimeras into real beings (a concrete example is the hybrid of a llama and a camel). The apotheosis of artifactual production is presumed to have reached an announced birth with Dolly (Provine, 1991) (if her technobioscientific innovation is confirmed) or with another mammal in the (more or less) near future. The mass media have taken charge of turning the fact (with or without quotes) into a spectacle, and the public repercussion has been huge, as we have witnessed. As the aesthetisizing 'prescription' would have it, we are now forced to represent and give meaning to something that clashes with our self-referential, narcissistic traits. In what we imagine as our self-production, there emerges the frightening possibility of artificial construction of otherselves that are not ourselves.

This is an untenable contradiction. We should keep in mind that we face the problem of the production of identity of self (representative of the species) *vis-à-vis* the construction of reflexive identity, of an active one's-self (the singularized person). In other words, of human self-awareness, involving a continuous and laborsome process of reconstruction through operations making compatible the 'conditions' of the organism from the world of 'nature' and the reflexive being from the world of culture (or second nature), through the quest for primacy of the latter over the former.

While Western culture is now increasingly governed by the technobiosciences [this expression was developed from Haraway's notion of 'technobiopower' (Haraway, 1997), which in turn stemmed from Foulcault's 'biopower'], with the 'Dolly case' we have reached a paroxysmal moment of perception of the uprooting of concepts of origin/reproduction of organisms in a context of pulverization of beliefs, myths, and symbols giving order and structure to reflexive identity. The notion of the active self is increasingly mediated, with the weakening of such identificatory matrices by disorganizing pressures throwing us off center from stabilized identities.

Santos (1995) diagnoses the current decontextualization of identity. But identities are 'necessary fictions' and "*hide negotiations of meaning, polysemous games, clashes in time frames, in a constant process of transformation, responsible, in the final analysis, for a succession of hermeneutic configurations which from one era to the next give body and life to such identities. Identities are thus identifications in progress*" (Santos, 1995:135). In his opinion, the modern way of conceiving of identity is through the idea of subjectivity. Yet there is tension in the interrelationships between the institutive vectors of contemporary subjectivities. There are two fundamental primacies: a) the individual over the collective vector; and b) the abstract/universal over the concrete/contextual vector.

We thus have the difficult task of dealing with the estrangement entailed in the fleeting of patterns of identity reference in Western culture. We are being forced to face the evanescence of the structuring notion anchored in the 'existence' of an *I* ordered on the basis of individuality and universality.

As we have seen, the quest for genomic revelation is not apocalyptic, since strictly speaking it will not succeed in revealing our essence. The risk of apocalypse/disaster is insinuated in the virtual revelation that, in the last analysis (gene mapping), science has not in fact provided a revelation of ourselves... In the words of the poet: "*The best way to reach nothing is to discover the truth*" (Barros, 1996:70). According to Castoriadis (1987) and Atlan (1991), we have reached the crossroads in this maze: we no longer succeed in basing ourselves on either traditional values like criteria for truth or (partial) truths produced by an illuminist science as criterion for belief.

We need a third road, with a change in our relations to truths and beliefs, a new wisdom allowing for the construction of a self that is contingent on new categories, where ideas relating to spirit/soul assume new statutes, distinct from those provided by beliefs that fail to achieve their ordering proposals and truths that have failed to replace them. Human subjectivity remains a problem for the biosciences due to its opacity towards the concepts, meth-

ods, and instruments that seek to reach its supposed 'essence'.

Why not imagine, as suggested by Varela (1992), that self should be built on the absence of self, without basing it on the (expired?) model of a unified, integrated 'I'? According to the concepts of Lacanian psychoanalysis, in the face of issues posed by contemporaneity, I believe it is possible to conceive in a preliminary fashion, and according to the etymology of 'subject' or 'submitted', that we increasingly have a 'subject a' which is (a)t the mercy not only of the Unconscious, but also of the effects of dizzying and constant sociocultural changes. Due to the uprooting of referential symbolic foundations that gave stability to identity in this moment of history, it is always possible to start from our primordial 'maps' of memory/experiences, instituting subjectivity, and further, to consider that in contemporary times, as it becomes even more problematic to construct relatively integrated and coherent *I's*, we thus have to operate contingently with the idea of a local, particular self, contingent on our way-of-happening *vis-à-vis* the vicissitudes of our lives...

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