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Colony of genes, genes of the colony: diversity, difference and divide

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ABSTRACT *In this article we propose an ideal typology of reactions to genomics—the study (in complex transnational organisational research arrangements) of the genome, the sum total of the genetic material in any particular organism—from the point of view and perspective of communities that find themselves in marginal positions. Genomics is a particularly important part of 'technoscience'—science mingled with technology. Within genomics the concepts of diversity and difference are paradoxically intermingled. Genetically speaking, the difference between human beings and nature is fading. Homo sapiens, viewed as genetic material, is becoming part and parcel of 'natural resources'. Diversity is the moral dimension of this perspective. At the same time genomics appears to map, mark and thereby define difference; difference between individuals and between groups of people, but also between healthy and ill, and finally between 'normal' and, consequently, 'abnormal', deviant. Difference is the moral dimension of this counterpoint. We argue that genomics is an important field of study for Africa. At the same time, however, we discern a potentially dangerous new divide: a genomics divide between Africa and the West. We argue that more research is needed on contextualisation of 'genomics'.*

In this paper we attempt to develop typologies of reactions to 'genomics', currently a paramount form of technoscience with important inherent presuppositions. We understand 'genomics' here as the study—in complex transnational organisational research arrangements—of the genome (the sum total of the genetic material in any particular organism), and we look at it specifically from the perspective of communities who find themselves in marginal positions *vis-à-vis* a Western dominant paradigm or knowledge-model.

Our epistemological perspective can be localised in what has been labelled 'social constructivism'. It is our contention that scientific knowledge is a product of people and contexts in which knowledge is constructed and operationalised. Scientific knowledge is thus a social construct and science is necessarily tied to definite social and historical conditions. 'True knowledge', in terms of an accurate representation of the world 'out there', separated from the more-or-less

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neutral observer does not exist in this line of thinking. Truth is not an absolute category somewhere 'out there' but a notion or concept that needs to be grounded and contextualised.

In the past 20 years or so research in the field of genomics has developed into a booming business, absorbing huge sums of money. Traditional dividing lines between research, industry and government, between the private and public domains, have been fading. If the double helix is the central metaphor in the domain of genomics, the triple helix—ie the intricate complex of academe, government and industry—should be the central metaphor in the process of developing, implementing and innovating research in the field of genomics.[1] 'Genomics' can be seen as what Knorr-Cetina has called an 'epistemic culture', those amalgams of arrangements and mechanisms—bonded through affinity, necessity and historical coincidence—which, in a given field, make us *how we know what we know*' (Knorr-Cetina, 1999: 1, author's emphasis), even if we don't explicitly know or claim that we know it. Genomics, being an organisational transnational network, is therefore not confined to specific socio-political control mechanisms.

Genomics research was organised at the beginning of the 1990s in the Human Genome Project. This project, acting as an umbrella for many research projects, is a massive government/private sector-funded, mainly US-based, undertaking. The Human Genome Project aims to sequence the entire human genome. The project has important implications, *inter alia*, for global health, as recognised by the World Health Organisation (WHO) in *Genomics and World Health* (2002).

Genomics research has developed into an interesting example of the way global systems of knowledge production in the domain of technoscience function. The organisation and institutionalisation of genomics research causes a blurring of borders between disciplines, between public and private institutions and their different inherent motives. But it also transgresses the boundaries of nations and cultures. It is an intriguing example of an increasingly transnational, transcultural practice of a Western technoscience. This technoscience is travelling around the world, seeking and provoking local answers and reactions to premeditated questions and agendas. A global flow of people and markets, financial investments, mental concepts, theories, practices, technologies, publications, etc is involved in this activity.

We argue here that the discussions related to genomics not only deal with 'objective realities' and a more-or-less rational process of comparing pros and cons but also (and perhaps even more) with world-views and philosophical presuppositions on which the arguments are based. We define 'world-view' here as the entirety of representations and notions about the world, life, human beings and the resulting ways of thinking and ethical conceptions (religion, philosophy, ideas about norms and values).

The core of our research is the articulation of the reception, interpretation and response to 'genomics' in different cultural contexts outside the Euro-American conceptual hemisphere, particularly in respect of its epistemological and ontological presuppositions, its practice, achievements, and its projections into the future.

The development of technoscience

Modern (or should we say Eurocentric?) science is based on the dichotomy of man versus nature. Humans want to domesticate nature and reduce it to legibility. RC Lewontin says in *The Doctrine of DNA: Biology as Ideology*:

> So, the ideology of modern science, including modern biology, makes the atom or individual the cause source of all the properties of larger collections. It prescribes a way of studying the world, which is to cut it up into the individual bits that cause it and to study the properties of these isolated bits. (Lewontin, 1991: 12–13)

Western science presupposes a fundamental disjunction of subject and object. We locate ourselves in opposition to, but also as part of, nature, the object of our search for knowledge. We regard 'the knower as fundamentally separated from the known, and the known as an autonomous "object" that can be controlled through dispassionate, impersonal, "hand and brain" manipulations and measures' (Harding, 1998: 364). In the Western philosophy of modernity, men (and women) are viewed and defined as autonomously thinking individuals: *cogito ergo sum* is the central plank of the philosophical system of René Descartes, the 'father' of modern Western philosophy.

Western science is determined, and regards itself as destined (in a sometimes theologically phrased wording), to make humankind and its environment legible, even into its smallest particles. It aims to read the 'Book of Nature' and the universe is viewed as a text that can be decoded and read. All other forms of knowledge are reduced to this dominant standard of the positivist, secular cosmology of Western science. It is based on the combination of an advanced technological knowledge and the specific modern Western drive to domesticate nature and reduce it to legibility (Scott, 1998; van Rinsum, 2001). More recently science has developed into what is called a technoscience; a blurring of 'traditional' science and a highly sophisticated technology.[2] A key element of technoscience is its ability (through the use of highly sophisticated instruments, including high-speed computers), to study, observe, represent, but at the same time intervene in, transform and mutate forms of life in their various shapes, including that of human beings.

> [Technoscience] means, that our own beliefs in nature as untouched and independent are giving way—with molecular technosciences from recombinant DNA to gene mapping and nanotechnology—to a new view of nature as artificially produced. (Escobar, 1999)

Technoscience is pre-eminently the domain of intricate organisational arrangements transgressing traditional and national boundaries of universities and research institutes, industry and government; arrangements in which different motives, different practices and different mechanisms of control interact.

The genesis of modern Western science dates back to the late Middle Ages, but its further development en route to global hegemony was connected with the way the West attained political and economic hegemony over the rest of the world. As Sandra Harding wrote: 'The world was added as a laboratory to modern science in Europe through European expansion' (1998: 58). This Western, once local, knowledge came to dominate other traditions of knowledge.

In its perspective science was seen as a metaphor of the process of modernisation that would finally triumph on a global scale. Local knowledge systems are supposed to be integrated or better submerged 'into this global scientific communications network, which historically was based in and controlled by the metropolitan center' (Wade Chambers & Gillespie, 2000: 231–232). One should avoid a clear-cut centre–periphery model. 'Contact-zones', hybridity, travelling in-between will give us deeper insights in the travels of science and technology. What we are interested in is a genealogy of technoscience.

The new technological developments that originated in Western research institutions threaten to re-colonise former colonies, eg in Africa, in a fundamental way. People, often characterised as indigenous people,[3] risk becoming the object of yet another search for natural resources, their genetic material. As David Wade Chambers and Richard Gillespie remark, 'Sadly, but not surprisingly, modern technoscience has been an active agent in the European global conquest, which has brought devastating consequences for nature and for other cultures' (Wade Chambers & Gillespie, 2000: 232).

Genomics as the paramount paradigm of technoscience

Genomics is pre-eminently a domain in technoscientific discourse with an inherently biomedical, reductionist world-view, which operates transnationally, using the internet as an important vehicle for communication. Paraphrasing Appadurai (1990), one could speak about an emerging global 'genoscape'.

In April 1953 an article in *Nature* (no. 4356), under the heading 'Molecular structure of nucleic acids', by JD Watson and FHC Crick, opened with the following statement: 'We wish to suggest a structure for the salt of deoxyribose nucleic acid (DNA). This structure has novel features which are of considerable biological interest.' This article, seminal in the development of 'genomics', proved to be of more than 'biological interest'. Genomics may be regarded as paradigmatic of the development of the Western concept of science. On 26 June 2000, the then President of the USA, Bill Clinton, gave a press conference, together with the UK Prime Minister, Tony Blair, on the occasion of the completion of the first survey of the human genome project. Clinton said:

> Today, we are learning the language in which God created life...What more powerful form of study of mankind could there be than to read our own instruction book?[4]

Genomics is a technoscience that enables us to classify nature and humans but at the same time it also offers the tools for intervention (Rabinow, 1992). As such genomics has far-reaching effects on the way 'life', 'human being', and 'identity' are being conceptualised and defined (see eg Nelkin & Lindee, 1995; van Dijck, 1998; van Have, 2001; Pääbo, 2001; Fujimura, 2000). Genomics allowed the introduction of new terms in thinking about human life like 'codes', 'blueprint' and 'mapping'. Walter Gilbert, one of the leaders of the Human Genome Project, said:

> Three billion bases of sequence can be put on a single compact disk (CD), and one

> will be able to pull a CD out of one's pocket and say, 'Here is a human being; it's me!'. (Gilbert, 1992: 96).

Interestingly, scholars working in the field of genomics sometimes use an almost religious terminology to denote the essence of their research (Nelkin & Lindee, 1995: 14–28). In genomics the identity of a human is analysed, in the strict sense of the word (ανα-λυσιζ, ana-lusis, 'to dissolve'), in the most radical, reductionist manner possible. Man is said to be merely a 'colony of genes' (Dawkins, 1989: 46).[5] Some scholars discern the development of a geneticisation of human identity (Abby Lippman, cited in van Have, 2001). Nelkin and Lindee talk about genetic essentialism, which they define as the reduction of self to a molecular entity. They show how the metaphor of genetic essentialism pervades popular culture (Nelkin & Lindee, 1995).

Academic disciplines in the humanities and social sciences, which claim to be primarily those domains that reflect on the '*condition humaine*', on the way people organise their lives and their societies, think and act, and transmit knowledge to future generations, are pre-eminently challenged by genomics to reflect on its practice, its presuppositions and consequences (Palsson & Rabinow, 1999; Cunningham, 1998).

Diversity and difference

Within genomics research the concepts of diversity and difference are paradoxically intermingled. On the one hand, it is reaffirmed time and again that, genetically speaking, human beings are more than 99% similar. The human genome appears to be not that different from that of a chimpanzee or even of a *Drosophila*, the fruit fly. Humanity's self-confidence took a terrible beating when we learned about the actual numbers of genes. Genetically speaking, the difference between *homo sapiens* and nature is fading. The base-pair structure of our genome appears to be very similar to that of the animals and even plants surrounding us. Man, seen as genetic material, is becoming part of 'natural resources'. Diversity is the moral dimension of this counterpoint.

But at the same time 'genetic information is both potentially embarrassing and uniquely personal' (Annas, cited by Everett, 2003). Genomics appears to map, mark and thereby define difference: difference between individuals and between groups of people, but also between healthy and ill and finally between 'normal' and, consequently, 'abnormal', deviant. For these reasons among others, this domain of biomedical research has potentially far-reaching policy implications. In its aim of isolating, determining and thereby defining the human being in its smallest particle, and in his/her absolute uniqueness, genomics goes against the concept of wholeness. Difference is the moral dimension of this counterpoint. In its wider epistemological and ontological ramifications, genomics colours the nature–nurture debate in a very specific manner. It revives a debate about the definition of 'race'; a category associated with the horrors of Nazi Germany, with the apartheid ideology in South Africa, and with the eugenics ideology that flourished in the USA and UK at the beginning of the 20th century. Troy Duster speaks about the 'Backdoor to eugenics' (2003). But whereas genomics is being

accused of promoting genetic essentialism, one must be cautious not to fall into the trap of essentialising genomics itself, thereby ignoring the complexities of this broad field of studies (see eg Keller, 2001).

Construction of typologies of counter-reaction from marginal groups

Genomics not only crosses national borders; it meets other cultural traditions in other continents. We argue that, from an epistemological perspective, genomics is paradigmatic for Western technoscience, a hegemonic system of knowledge that is working on a global scale. It is a specific branch of this science that gives meaning to knowledge but at the same time defines identity, of peoples, of human beings, of living organisms.

The articulation of answers, comments from 'non-Western' and marginal perspectives to this dominant system of knowledge is of major importance. The word 'marginal' needs clarification. Marginality is not an absolute, static category. It is not only about nation-states of the so-called Third World countries. Within countries and regions—also in the industrialised world—one can assess structures of dominance and marginality. Below we discuss the case of the group of African American scholars working in the USA and the group of historically black universities and colleges there such as Howard University and Tuskegee University. If one compares the state of the art of these universities with some other universities, eg in Africa, one will find that marginality is always relative.

Sub-Saharan Africa seems to be one of the marginal areas. It has been categorised as the 'Dark Continent', 'Third World', the 'periphery', 'remote', etc. These areas became the object of 'development'. Now the concept of development has been debated heatedly. Metaphorically speaking, development is equated with the process of 'unfolding or growing naturally to the fulfilment of a potentiality' (Hobart, 1993). In the process of development, local religious systems, local systems of knowledge are being reduced to a location on the road to fulfilment, which is the establishment of the hegemony of (the Christian) religion and its secular counterpart, the system of knowledge that culminates in the scientific knowledge of the dominant West.

Large donor agencies, including the World Bank, have reached the conclusion that development, based on Western premises of modernity, has failed (see Scott, 1998). The term that has come into vogue nowadays in some development co-operation circles is 'indigenous'. It is seen as the answer to a Western-coloured process of development, tracing its footsteps back to the Rostow thesis of the take-off.[6]

'Indigenous' also refers to culturally specific, local systems of knowledge production. 'Indigenous Knowledge Systems' (IKS) is an umbrella concept denoting a 'people's knowledge system', indigenous modes of knowledge production. Some of the important characteristics of this knowledge production are its locality, its orality, and its practicality in everyday life. IKS is sometimes used as countervailing asset to a Western dominating science. Notwithstanding the present 'development' connotation of the word 'indigenous', Western explorers, merchants, mercenaries and academics have a long tradition of extracting

	Difference	*Diversity*
Epistemological pluralism	NGOs/pressure groups	Maori/Aboriginals
Technoscience	African American academics	Asian philosophy

FIGURE 1.
A matrix of typologies.

not only minerals, cash crops, spices, etc from 'marginal areas' but also 'indigenous' (or 'embodied') knowledge from its local cultural context, as raw material, in order to appropriate, process and finally redefine it (Agrawal, 1995; Ellen & Harris, 1996; Ziff & Rao, 1997).

Based on the existing literature we develop four different typologies of articulation below. We also propose a matrix with two axes: a vertical axis running from technoscience to epistemological pluralism and a horizontal axis running from *difference* to *diversity*. A visual model would be that of a square split up in four quadrants (see Figure 1).

We define 'diversity' in the sense of '*bio*diversity', variation among living organisms. We refer to the text of the UN-Convention on Biological Diversity (1992), in which it is defined as:

> the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

In this way 'diversity' relates to a concept of holism and communalism and emphasises the fact that we, human beings, are first and foremost 'part of' a whole.[7]

Through politics of cultural difference, people, groups of peoples, sexes, age groups, etc are defined and categorised, resulting in processes of inclusion and exclusion, marginalisation, etc. The politics of difference is inextricably bound up with power. We refer to the postcolonial writer, Homi Bhabha, who said:

> cultural difference is a process of signification through which statements of culture or on culture differentiate, discriminate, and authorize the production of fields of force, reference, applicability, and capacity. (1995: 206)

It could be argued that diversity *exists* (among living organisms), whereas difference (between living organisms, peoples, human beings, sexes, etc) *is made*.

Typology 1: technoscience x difference—African American scholars

The first typology is that of African American scholars who 'are keenly aware of the subjective cultural, social, political, and economic assumptions underlying much of "objective" science' (Jackson, 1999: 182). African-American academics formulate their criticism on genomics from the perspective of 'difference' and 'technoscience'. Being a minority, they outline some of the policy implications of genomics. These scholars, coming among others from historically black universities and colleges, including Tuskegee University and Howard University, point out that the Human Genome Project has a northern, Eurocentric 'constructed norm' of 'normality' (Jackson, 1999; 2000) in its sampling strategy.

But at the same time these scholars emphatically want to have a fair share in the various phases of the genomics research (research design, sampling strategy, etc). Therefore, a National Human Genome Research Centre (as part of the overall HGP) was established at Howard University, a 'minority-serving institution' in 2001. This centre will focus on genetic research that has major health implications for people of African descent.

The scholars expressed their concerns in a *Manifesto on Genomic Studies among African-Americans* published in 1994. This manifesto includes six key points:

1. African Americans expect full inclusion in any world survey of human genomic diversity.
2. Any sampling needs to include the full range of variation among African Americans.
3. African Americans must be represented in all aspects of the research process.
4. Through a national review panel African Americans will evaluate genomic studies for their impact on African American communities.
5. Priority will be given to genomic studies that examine the linkage of African Americans to continental Africans and other Africans of the diaspora (eg the so-called Genomic Research on African Diaspora (GRAD) project).
6. Genomic sampling of African Americans will be linked to improvements in the provision of health and educational services to the African American community.

Recently, there have been research lines in genomics among African American academics which aim at identifying the genetic roots of African Americans in order to 'restore the specifics of identity that were deliberately damaged by slaveholders in order to make enslaved Africans seem less human' (Dr Michael L Blakey, quoted in the *New York Times*, 28 August 2000). Here, then, technoscience can be an instrument of identity construction.

Typology 2: epistemological pluralism x difference: indigenous oppulations and their representatives

The second typology is characterised by 'epistemological pluralism' and difference. For example, the communities of indigenous peoples, including Maoris, Aboriginals and American Indians and Amerindians seem to position themselves in opposition to the dominant technoscience system. They see themselves first and foremost as 'research objects and testing sites for theories, methods, and products generated in Euro-America' (Fujimura, 2000). (Re)colonialism, imperialism and Western science are intermingled (see Smith, 1999). They argue that it was (techno)science that marginalised their own knowledge systems.

These communities see genomics as another example of the practice of Western appropriation (Ostergard *et al*, 2001). 'Genomics' stands in line with what James Clifford has labelled 'culture collecting'. He wrote: 'Collecting – at least in the West, where time is generally thought to be linear and irreversible—implies a rescue of phenomena from inevitable historical decay or loss' (Clifford, 1988: 231). The Human Genome Diversity Project (HGDP), in particular, stirred opposition. This project was proposed in 1991 next to the Human Genome Programme (Reardon, 2001; Resnik, 1999). Cavalli-Sforza *et al* (1991) suggested that the genetic material of 'isolated populations' of historical interest be sampled and stored in the HGDP 'to record human ethnic and geographic diversity before this possibility is irretrievably lost'. The project's original aim was to divest the Human Genome Project of its allegedly Eurocentric mould by giving a central place to the concept of human diversity.

The HGDP soon encountered heavy and well articulated criticism from (representatives of) indigenous peoples. They argued that genetic material is pre-eminently 'embodied' knowledge and not so much a commodity that can be negotiated in a market place. The issue of (intellectual) property and informed consent is at the heart of the heated discussion about the HGDP—opponents sometimes label it the 'Vampire' project—and its practice of patenting human genetic material. Tauli-Corpuz (nd) speaks of 'biocolonialism'. Others use the term 'biopiracy'. The important transnational channel of opposition is the use of the internet (Indigenous Peoples Council on Biocolonialism, at www.ipcb.org).

Typology 3: epistemological pluralism and diversity: ontology of indigenous communities

However, we think that the picture is more complicated. The quadrant difference–epistemological pluralism relates to the experiences of indigenous communities in a globalising world. But, if we analyse the world-view, the ontology of these communities, including Maori, Amerindians, etc, it would position them in the quadrant of epistemological pluralism and diversity, Typology 4. Their thinking is characterised by a strong emphasis on holism, integrity, inter-relatedness, sacredness and the human being as part of the community of living organisms.

The human gene is a physical gene but it is also imbued with, and thus inseparable from, a life spirit handed down from its ancestors. In this way

biotechnology, genomics, as manifest in the HGDP, is seen to be 'disrespectful of the integrity of nature, life, the ancestors—all that is sacred' (Aroha Te Pareake Mead, 1996: 49).

Typology 4: technoscience and diversity: Asian philosophical thinking

The perspective of holism and integrity is emphatically present in some of the Asian perspectives on genomics. People in far Eastern countries that seem to be able to incorporate the technoscience perspective in their own philosophical framework without sensing a contradiction offer a fourth typology. Joan Fujimura's article, 'Transnational genomics', deals with the Japanese Human Genome Project. As Fujimura's spokesman, 'Professor Suhara' (a pseudonym), a leading molecular biologist, indicates, Asian philosophical thinking enables people to amalgamate technoscience, ie genomics, and a deeply felt experience of belonging to the total world of living organisms without making the separation between man and nature. Identity in Asian perspectives is particularly based on a relational orientation.[8] In Buddhism life is not just generated from a purely physical union of sperm and egg. It requires a metaphysical force or energy, arising from the karmic cycle, for a body to become animated.

In this respect genomics is even more congruent with Asian values than with Western ones because (in the words of Suhara):

> I think people will share a sense [of our place in nature] and forget about human dignity. Too much stress has been placed on human dignity [in the West]. It's much easier for us [in Japan] to accept [man's place in nature] because we have not been brought up under the influence of Christianity. Most Japanese are either Buddhist or Shinto, and they have a much wider view of all living things. They don't put man as the representative of God to be placed above all the other living things...[The Japanese have a] much cooler concept of man. We look at man as one [among other] living creatures. (Fujimura, 2000: 80)

Genomics in Africa x African genomics: different trajectories?

New genetics will affect the way we look at 'identity', the identity of individuals and of groups. We argue that 'new genetics', being an identity-constructing science, shows two fundamental counterpoints that relate to 'African' thinking.

Keeping in mind our matrix, one can imagine different trajectories of counter-reactions to genomics and its consequences. One of them is the trajectory of indigenous knowledge systems, emphasising diversity and holism, opposing the politics of difference, but leaving out the reductionist technoscience perspective. We refer to the writings of one of the authors of this article, Godfrey Tangwa, who, drawing his material from the Nso' of the northwestern region of Cameroon, is developing an African bioethics (Tangwa, 1996; 1997; 1999; 2000). The nucleus of his African bioethics is what he calls 'eco-bio-communitarianism', an amalgamation of ecology, bioethics and communalism. One can easily find striking parallels with the Ubuntu-philosophy as developed in South Africa.[9]

Then there is the trajectory of modern technoscience, trying to catch up with

technological developments in Western countries and Western research institutions. Since bio-informatics is one of the important sub-disciplines of genomics, African scholars and institutions can use the internet as an important channel for trying to keep up with developments in Western countries. Some universities in South Africa particular have taken the lead in this trajectory. Several African NGOs are also strongly promoting research capacity building in the field of genomics in Africa. However, it is still to be seen whether this technoscience trajectory will sufficiently take into account the cultural and moral dimension of this system of knowledge. Most probably, a hybridisation of different trajectories is on its way.

Genomics in Africa: a new divide

It is widely accepted that genomics is a scientific research endeavour that might, potentially at least, be highly relevant to the well-being of all humanity (and animals, we should add). Advocates of genomics argue that the world food and health situation may benefit on an unprecedented scale from developments in this field. Genomics is indeed seen as, at least potentially, a blessing for people in developing countries suffering from shortages of food and medicines (to treat AIDS, for example).

However, the reactions of the developing countries reveal a certain ambivalence. Next to the projected blessings, people warn against a looming new divide (see eg Singer & Daar, 2001; Bloom & Trach, 2001; Benatar, 2002). Many countries, regions, and even entire continents, run a high risk of being excluded from the benefits of genomics. Genomics is then interpreted by peoples and NGOs in developing countries, as the way 'the West' extracts raw, ie genetic, material from the periphery, processes and transforms it in its own laboratories in the 'centre', and brings it back into the global market of food and health. Unfortunately, that market is not accessible to most people in developing countries. Here is a political economy at work in genomics. The case of genetically modified maize in Zambia is another painful example of this political economy.

Our typologies show a divide that can also be phrased in terms of different cultural traditions. As said before, genomics represents a perception of the human being and, therefore almost by necessity, of health and (potential) illness, which is mainly defined in biophysical terms. But any medical system is an integral part of a society. That means that different cultural traditions will conceptualise health and illness in different ways. Within a society different interpretations can interact and intermingle. This may lead to a culture-specific interpretation of the application of the results of genomics research (for different concepts of health and illness, see Lindenbaum & Lock, 1993; Helman, 2000). What is the effect of different cultural, and thus epistemological and ontological, traditions in which research like genomics, an epistemic culture in itself, will be interpreted? Are there typically 'African', indigenous, Maori, etc answers to this type of research? We strongly plead for further research on the contextualisation of genomics in different cultural settings. The critical question, however, is this: (how) can genomics, and science and technology in general, proceed henceforth

without the will to or fear of hegemonic domination, exploitation, marginalisation, enslavement?

Notes

[1] See, for example, Leydesdorff & Etzkowitz (2001).
[2] Wolf Schäfer (2001) talks about 'a hybrid of scientized technology and technologized science'.
[3] The Human Genome Diversity Project aimed at the development of a gene bank comprising genetic material of 'isolated populations of historical interest' (Cavalli-Sforza *et al*, 1991).
[4] Press Release of the White House, Office of the Press Secretary, 26 June 2000 (text downloaded from internet).
[5] Dawkins said in his *The Selfish Gene*: 'I prefer to think of the body as a colony of genes...'
[6] The Rostow thesis found its counterpart in Basella's (1967) famous article on the diffusion of science.
[7] Note that 'biodiversity' as such is not an essentialist definition and is in itself a construction. See Escobar (1998) who said: 'From a discursive perspective, then, biodiversity does not exist in an absolute sense. Rather, it anchors a discourse that articulates a new relation between nature and society in global contexts of science, cultures and economies' (p 55).
[8] See, for example, Ho (1993).
[9] See, for example, Louw (nd).

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