Studies in the anthropology of reason

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In a recent book, *French Modern: Norms and Forms of the Social Environment*, I argued that the term 'society' is not some universal thing, an object waiting to be described, found everywhere and studied by sociologists and anthropologists simply because it is there, which just happens to take several thousand years to discover. Rather, 'society' as an object open to empirical analysis and planned change emerged in the early 19th century in concert with, and as an integral part of, the vast economic, political and cultural changes sweeping Europe. Society and the social sciences, the argument runs, are the ground plan for modernity, the milieu from which social understanding and social planning emerge. *French Modern* charted the century-long development of knowledges (medicine, public health, architecture, statistics, biology, geography, sociology) and powers (medical, industrial, medical, academic) which led to urban planning in the French world.[1] My current research begins with the hypothesis that the category 'life' is now undergoing a parallel modernization.

The anthropology of techno-science

This 'anthropology of reason' seeks to further the tradition of social and historical enquiry associated with Max Weber and Michel Foucault as well as the history of science as practised by Georges Canguilhem and a wave of contemporary practitioners.[2] The social study of science is by now a small but burgeoning multi-disciplinary field. The first decade of social constructivist studies were more or less united in their opposition to older ways of studying science. Beginning with the works of Thomas Kuhn and accelerating in a rather different direction with those of Bruno Latour, these diverse studies of the local practices of science have sought (with some success) to lower-case the abstractions of Science, Reason, Truth and Society. They have done so through fine-grained observation of what goes on in laboratories and related spaces rather than in the biographies of great men or the logical structure of scientific theories. Steve Woolgar, one of the field's founders, concludes: 'Discoveries and experimental findings are better understood as social constructions than as reflections of the character of the natural world; matters of "social" and "scientific/technical" concern can no longer be considered distinct ... the facticity of a knowledge claim is the product, rather than the cause, of agreement within a scientific community'.[3] Although generally carried out by non-anthropologists, anthropological approaches have been influential in shaping the social studies of science. The method of choice has been participant observation which carries with it an 'analytic scepticism' toward the natives. ¶If the traditional anthropological task has been to make 'the exotic ordinary' as Georges Condominas put it, social studies of science have focused on everyday laboratory activities to show how the big abstractions of science are products of these local practices.[4] Today, however, as some philosophers and historians of science have incorporated these insights, the field is ripe for re-appraisal and ready to explore new directions.

One logical place to begin such an exploration is the Human Genome Initiative, sponsored in the U.S. by the National Institutes of Health and the Department of Energy with smaller associated projects in Europe and Japan, whose mandate is to produce a map of our DNA. By its very nature, the Human Genome Initiative and the technologies which make it possible, provides an excellent object of study for what has been called the 'new ethnography', one requiring both local and international research loci as well as a focus on the interconnections of social and scientific technologies.[5] The Human Genome Initiative is very much a techno-science project in two senses. Like most modern science the Initiative is deeply imbricated with technological advances in the most literal way, in this case the confidence that qualitatively more rapid, accurate and efficient machinery will be invented if the money is made available. This is already happening. The second sense of technological is the more important and interesting one; the object to be known – the Human Genome – will be known in such a way that it can be changed. This dimension is thoroughly modern, one could even say it instantiates the definition of modern rationality. Representing and intervening, knowledge and power, understanding and reform, are built in from the start simultaneously as goals and means.

My initial stance toward the Genome Initiative and associated institutions and practices is rather traditionally ethnographic: neither committed nor opposed, I am seeking to describe what is going on. My ethnographic question is: how will our social and ethical practices change as this project advances? I approach this question on a number of levels and in a variety of sites. First, there is the Human Genome Initiative itself. Second, there are adjacent enterprises and institutions in which and through which new understandings, new practices and new technologies of life and labour will certainly be articulated: prime among these is the biotechnology industry.

What is the Human Genome Initiative? A genome is 'the entire complement of genetic material in the set of chromosomes of a particular organism'.[6] The variable part of the DNA structure is composed of four bases which bond into two kinds of pairs wound in the famous double helix. The current estimate is that we have about three billion base pairs in our DNA; the mouse has about the same number while corn or salamanders have more than thirty times as many base pairs in their DNA as we do. No one knows why. Most of the DNA has no known function. It is currently held, not without a certain uneasiness, that 90% of human DNA is 'junk'. The renowned Cambridge molecular biologist, Sydney Brenner, makes a helpful distinction between 'junk' and 'garbage'. Garbage is something used up and worthless which you throw away; junk is something you store for some unspecified future use. It seems highly unlikely that 90% of our DNA is evolutionarily irrelevant, but precisely what that relevance is is currently unknown.

Still, even when the whole human genome is mapped, we will know, as Charles Cantor, a vice-president of the Human Genome Organisation, has said, nothing about how it works.[7] We will have a kind of structure without function. Much more work remains to be done, and currently is being done, on the hard scientific problems: protein structure, emergent levels of complexity and the rest. Remember the entire genetic information for making a human being is found in most of our cells; how a cell becomes a brain cell and remains one instead of a toe cell is currently unknown.

As a social scientist I could only be struck with the atmosphere of the *Human Genome* meeting in San Diego where participants eagerly presented summaries of vast accumulations of new data, significant new knowledge, a variety of innovative and powerful techniques and technologies. Still, the long range significance of all this knowledge remains a question. Is the DNA sequence really 'the language of life?' Are we witnessing an epochal change in our relationship to the world? Are we on the verge of becoming 'masters of life and death?' To what extent have the modernist critiques of Marx, Weber and their heirs been superseded today in a situation when we are not only exploiting, rationalizing and controlling nature but also remaking it as well? In the name of what ethics and what politics are we to evaluate these developments? Perhaps for the moment, as numerous scientists and a growing corps of professional ethicists are mobilized by a large influx of money and interest, the ethnographic stance is the most appropriate one to adopt. After all, the 'fact' versus 'value' distinction, with its corresponding bureaucracies and discursive productions, certainly forms an appropriate object for Weberian ethnographers of late modernity.

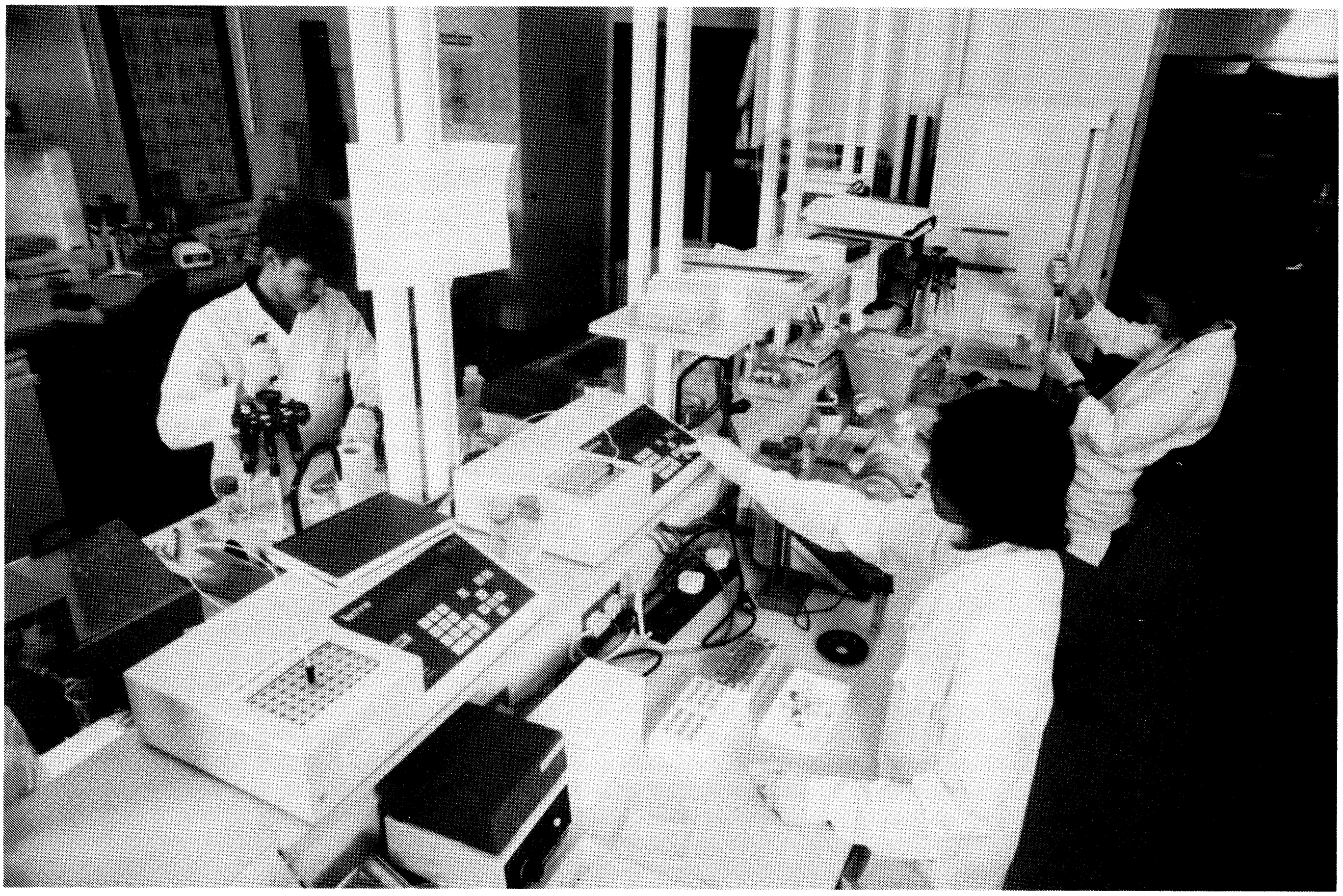
PCR: An enabling technology

As early as 1963 C.P. Snow argued that in molecular biology, the line between science and technology was becoming increasingly hard to draw.[8] His hypothesis has been verified. The burgeoning field of the social studies of science as well as the experiences of governmental technology assessment has cast doubt on the utility of drawing sharp dichotomies between technology and society, experts and public.[9] As Madeleine Akrich puts it, the ballistic approach – the impact of technology on society – is too simple.[10] The distinction between society and technology is less a starting point than a result of a process of construction and negotiation. The development of new technologies is rarely the linear project presented on organizational charts or retrospective triumphalist accounts. We now more adequately understand how technology development integrates a series of choices taking into account a variety of constraints and potentials from the raw materials, to the market position of the enterprise doing the development, to the social dynamics of the institution, to the state of the problem being attacked, to serendipity, and how that serendipity is developed and managed.[11] Camille Limoges and Alberto Cambrosio's approach to 'technological systems' not as 'a specific instrument or technique, but the particular arrangement of instruments, techniques, materials and models which has been mobilized by one or several major research programs in the field', seems the most promising one available today.[12]

However, too strong an emphasis on the social construction of technology may merely reinforce or displace the original technology versus society split it was seeking to overcome. We must develop more sensitive means for weighing components of the background from which specific technologies emerged, as well as analysing how the contexts within which they are introduced are themselves the partial product of a long series of technological and scientific innovations and adaptations. There is a growing literature on computers and information technology which demonstrates how the same technology operates differently in different circumstances. In fact, the power of certain technologies relies precisely on an ability to produce variation. Just as the line between technology and society has been blurred, so too the line between the invention of a technology and its implantation is disappearing. Both are on-going complex processes.[13] The study of scientific instruments is a useful means of gaining insight into the social and cognitive structures of scientific activity; Price argues that social groups in the sciences are bound together by instrumentalities.[14] Despite these insights it is striking that many approaches to the social evaluation of technology are silent about the technology itself. This has come to be known as the 'black box' or 'package' phenomenon.[15] It is suggested that scientific instruments operate as 'black boxes' when most users of the instrument no longer need to understand the theories embodied in the apparatus and rely upon the standard interpretation of the data generated by the instrument. One component of this research consists in exploring the black box of one of the most fundamental and enabling biotechnologies which has emerged to date: the polymerase chain reaction (PCR).

The polymerase chain reaction, chosen by *Science* as 'molecule of the year' in 1989, is an 'increasingly powerful, versatile, and useful technique' to amplify DNA.[16] The idea is simple and the consequences important. Complementary strands of DNA are separated by heating. Oligonucleotide primers are used to bind to a specific sequence at one end of a target sequence. Polymerases start at each primer and copy the sequence of that strand. This procedure is repeated by machine and the replication is geometric. This means that within a few hours it is possible to have millions of copies of the specific bits of DNA one is interested in understanding or manipulating. With PCR, scarcity turned into bounty. Numerous variations on the technique have been invented since the first PCR papers were published in 1985. Thousands of scientific papers building on PCR-based experiments have appeared.

The ethnographic research is being conducted at a leading biotechnology company, including attending weekly lab meetings where trouble-shooting for ongoing projects takes place, providing an excellent observatory of techno-science as process. In addition, extensive general and specific discussions with scientists, technicians and lawyers are on-going. Researching a technology like PCR clearly can't stop at the laboratory door. Following the intersection of legal and scientific domains of truth in a patent trial has proved a fruitful device for setting the historical and institutional scene in which the spectacular advances in bio-technology over the last two decades have flourished. An important patent dispute between Cetus Corporation and Dupont Corporation over the invention of PCR was brought to trial in San Francisco during the winter 1990-91. The legal strategy chosen by Dupont provides us with a



Identifying YAC (Yeast Artificial Chromosome) clones by polymerase chain reaction. These researchers are working in the Human Genome Mapping Project Resource Centre, Harrow, near London. The UK HGMP is funded by the Medical Research Council.

A useful article about the huge international research effort, by Sir Walter Bodmer (president of the Human Genome Organisation) and Liz Evans, was published by the Royal Society in Science and Public Affairs, *Autumn 1991 ('HUGO's there!'). Among the major participants in the British contribution to the project is the Imperial Cancer Research Fund. (Photo courtesy of HGMP Resource Centre, Harrow, Middlesex.)*

detailed case study for exploring the state of microbiology, its problematics and technologies, during the fifteen years or so of its most rapid development. Dupont held that developments at the M.I.T. laboratories of Nobel Prize winner, Professor Khoranna, some twenty years earlier had made the principles of PCR technology 'commonly available'. Attorneys for Cetus rebutted this interpretation. The trial transcripts, as well as extensive interviews with participants (scientists, lawyers, industry analysts) provide a logical beginning point for exploring the emergence and development of PCR as a technological system. Granting that the 'potential' for certain breakthroughs is available over an extended period of time, one can ask: how is it that such techno-science-social breakthroughs occur when and where they do? Answering this question will provide both a narrative means of laying out the essential molecular biological and genetic engineering history as well as contrasting university vs. biotechnology industry work environments. It will problematize different domains of the production of truth from the development of the instrumentation itself to the status of patent law.

Three case studies will move the narrative forward from the mid-1980s to the present. They will thematize the flexible 'enabling' uses of PCR. The first is the step-by-step laboratory development of a diagnostic kit for an intestinal parasite, *giardia*, common in day care centres. PCR techniques are employed to identify the genetic identity of this pathogen. This information is then used to develop a broad-based and reliable diagnostic kit in order to replace the current highly intrusive one. This case study will explore how PCR encounters a common non-lethal public health problem. It is through the avenue of such mundane developments that that everyday life will enter into François Gros' 'genetic civilization'.[17]

The second example explores the use of PCR in the context of molecular systematics. Molecular classification techniques, developed at the UC Berkeley laboratory of the late Alan Wilson, are being used to refine the classification of pathogenic fungi. This work will provide a framework to show how the transformation of classification systems from morphologically based to genetically based systems, via computer technology, is being carried out. Debates about classification of fungi demonstrate the powerful mutual interfaces of computer technologies (data banks, tree programs), molecular systematics, and PCR based diagnostic applications. It is an essential hallmark of our knowledge that it is tightly linked to applied uses. The DNA sequence data fed into GenBank flows to and from university and industry labs alike. This data and their classificatory implications orient and accelerate the search for diagnostic and eventual therapeutic uses. The importance of how we classify nature can hardly be overestimated especially when the tools for that classification are ones which will enable intervention as well.

If the classification of micro-organisms is changing through the use of molecular biological techniques enabled by PCR, so, too, is the classification of humans. PCR is a crucial element in the reshaping of forensics. Embedded in such technologies as the HQ-alpha system developed at Cetus technologies are new 'classificatory rationalities', linking our identification of individuals to the statistics of population genetics. Controversy over the reliability of DNA based forensics has centred on the need for a national regulatory body to establish reliable laboratory standards as well as for more extensive population statistics for sub-groups within (American) society. Meeting these criticisms will accelerate the scope and power of this technology. The biology of ethnic differences, largely a taboo topic in the American public domain since World War 2, is now beginning to re-emerge, carried by a rather unlikely coalition of forensic technicians, geneticists, lawyers and ethicists.

Bio-sociality

My educated guess is that the new genetics will prove to be an infinitely greater force for reshaping society and life than the revolution in physics ever was, because it will be implanted throughout the social fabric at the micro-level by medical practices and a variety of other discourses. The new genetics will carry with it its own distinctive promises and dangers.[18] Previous eugenics projects have been modern social projects cast in biological metaphors. Their social effects have ranged from public hygiene to the holocaust but none of them had much to do with the serious speech acts of biology, even if they were all deeply imbricated in discourses of truth.[19] Socio-biology, as Marshall Sahlins and so many others have shown, is a social project: from liberal philanthropic interventions designated to moralize and discipline the poor and degenerate; to *Rassenhygiene* and its social extirpations; to entrepreneurial socio-biology and its supply-side conception of human capital: what has been at stake has been the construction of society.[20] In the future the new genetics will cease to be a biological metaphor for modern society and become a circulation network of identity terms and restriction loci, around which and through which a truly new type of auto-production will emerge: let's call it 'bio-sociality'. If socio-biology is culture constructed on the basis of a metaphor of nature, then in bio-sociality, nature will be modelled on culture understood as practice; it will be known and remade through technique, nature will finally become artificial, just as culture becomes natural. □

1. Paul Rabinow. *French Modern: Norms and Forms of the Social Environment* Cambridge: MIT P., 1989.
2. Georges Canguilhem, *On the Normal and the Pathological.* New York: Zone Books, 1989 (original 1943, 1966); *Ideology and Rationality in the History of the Life Sciences.* Cambridge: MIT P. 1988 (original 1977).
3. Steve Woolgar. 'What is "Anthropological" about the Anthropology of Science?' *Current Anthropology* Vol. 32, No. 1, Fe. 1991. p. 79. Some of the representative works in this style include: K.D. Knorr-Cetina. *The Manufacture of Knowledge: An Essay on the Constructivist and Contextual Nature of Scientific Knowledge.* Oxford: Pergamon, 1981; Bruno Latour and Steve Woolgar, *Laboratory Life: The Construction of Scientific Facts.* Princeton: Princeton U.P. 1986 (1979) 2nd ed.; Michael Lynch, *Art and Artifact in Laboratory Science.* London: Routledge and Kegan Paul, 1985; M. Lynch and S. Woolgar, eds., *Representation in Scientific Practice.* Cambridge: MIT P., 1990.
4. Georges Condominas. *L'Exotique est quotidien.* Paris: Plon, 1965.
5. Paul Rabinow. 'Representations are Social Facts: Modernity and Post-Modernity in Anthropology', in James Clifford and George Marcus, eds. *Writing Culture.* Berkeley: U. of California P., 1986. For an analysis of what is meant by 'social technologies', see: Hubert Dreyfus and Paul Rabinow, *Michel Foucault: Beyond Structuralism and Hermeneutics.* Chicago: U. of Chicago P., 2nd ed. 1982, Part II.
6. *Mapping the Human Genome*, p.21.
7. Charles Cantor. 'Opening Remarks', *Human Genome: I.* San Diego, 1 October 1989.
8. C.P. Snow. 'A Second Look, in *The Two Cultures and A Second Look.* Cambridge: Cambridge U.P., 1964, p. 67.
9. Bruno Latour and Steven Woolgar, *Laboratory Life.* Beverly Hills: Sage, 1979. Bruno Latour, *Science in Action: How to Follow Engineers and Scientists through Society*, Cambridge: Harvard U.P. 1987. Barry Barnes and David Edge (eds.), *Science in Context. Readings in the Sociology of Science*, Cambridge: MIT P., 1982. Wiebe E. Bijker, Thomas Hughes and Trevor Pinch, *The Social Construction of Technological Systems*, Cambridge: MIT P., 1987. Karin Knorr-Cetina and Michael Mulkay (eds.) *Science Observed. Perspectives on the Social Study of Science*, London: Sage, 1983.
10. Madeleine Akrich, 'La construction d'un système socio-technique. Esquisse pour une anthropologie des techniques', *Anthropologie et sociétés*, Vol. 13(2), 1989. 'Comment décrire les objets techniques', *Techniques et Culture*, Vol. 5, 1987.
11. Stephen Barley, 'Technology as an occasion for structuring: evidence from observations of CT scanners and the social order of radiology departments', *Administrative Science Quarterly*, Vol. 31, pp. 78-108, 1986. Geoff Bowker, 'Recherche industrielle et industrialisation de la recherche', "Culture technique, No. 19, pp. 146-153, 1988. Alberto Cambrosio, Camille Limoges and Denyse Pronovost, 'Representing Biotechnology: An Ethnographic Study of Quebec Science Policy', *Social Studies of Science*, Vol. 20., 1990. Camille Limoges, 'Analyse evaluative et évaluation sociale des technologies: une pragmatique sociale', in Anita Caron and André Michaud (eds.) *CIEST. Receuil des Activities*, Montreal: Presses de l'Université du Québec, pp. 259-279, 1988. Otto Mayr, 'The science-technology relationship as a historiographic problem', *Technology and Culture*, Vol. 17, pp. 663-72, 1976. Arie Rip and Peter Groenewegen, 'Les faits scientifiques à l'epreuve de la politique', in Michel Callon, ed. *La science et ses réseaux. Genèse et circulation des faits scientifiques*, Paris: La Découverte, pp. 149-172, 1989.
12. Personal communication.
13. Alfonso Hernan Molina, *The Social Basis of the Micro-electronics Revolution*, Edinburgh: Edinburgh U.P., 1989. Rob Kling, Walt Scacchi, 'The Web of Computing: Computer technology as social organization', in *Advances in Computers*, Vol. 21, 1982, pp. 1-90.
14. Thanks to Camille Limoges for these formulations. M. Borell, 'Instruments and the rise of physiology', *Science & Technology Studies*, Vol. 5(2), pp. 53-62, 1987. Price. Sharon Traweek, *Beam Time.*
15. Nathan Rosenberg, *Inside the Black Box: Technology and Economics*, Cambridge: Cambridge U.P. 1982. Bruno Latour, 'Visualization and Cognition: Thinking with Eyes and Hands', *Knowledge and Society: Studies in the Sociology of Culture Past and Present*, Vol. 6, 1986, pp. 1-40. D.J. de S. Price, 'The science/technology relationship, the craft of experimental science, and policy for the improvement of high technology resolution', *Research Policy*, Vol. 13, pp. 3-20, 1984. Joan Fujimura, 'Constructing "do-able" problems in cancer research: articulating alignment', *Social Studies of Science*, Vol. 17, pp. 257-93,1987.
16. Ruth Levy Guyer, Daniel Koshland, Jr., 'Molecule of the Year', *Science*, Vol. 246, 22 December, 1989, p. 1543. [Strictly speaking, the award was given to the DNA polymerase molecule that drives the reaction. *Editor*]
17. François Gros, *La Civilisation du gène*, Paris: Hachette, 1989.
18. Kevles, Daniel and Heilbron, John. Both Kevles and Heilbron agreed with the importance of the social impact of the Initiative. Heilbron: 'Oh a thousand times more important'. 14 Feb 1990.
19. For this distinction see: Hubert Dreyfus and Paul Rabinow, *Michel Foucault. Beyond Structuralism and Hermeneutics*, 2nd ed., Chicago: U. of Chicago P. Chapter 3.
20. Marshall Sahlins, *The Use and Abuse of Biology: An Anthropological Critique of Sociobiology*, Ann Arbor: The U. of Michigan P., 1976. Robert N. Proctor, *Racial Hygiene, Medicine Under the Nazis*, Cambridge: Harvard U.P., 1988. Daniel J. Kevles, *In the Name of Eugenics. Genetics and the Uses of Human Heredity*, Berkeley: U. of California P., 1985. Benno Muller-Hill, *Murderous Science. Elimination by Scientific Selection of Jews, Gypsies, and Others, Germany 1933-45*, Oxford: Oxford U.P., 1988.