Science Technology & Society

http://sts.sagepub.com/

Mode 2 or the Emblematic Disestablishment of Science: A View from the Edge

Hebe Vessuri

Science Technology Society 2000 5: 195

DOI: 10.1177/097172180000500204

Mode 2 or the Emblematic Disestablishment of Science: A View from the Edge

HEBE VESSURI

IN THE TRANSITION to the twenty-first century we witness such wanderings in the philosophical, social and political assessment of science as to seem wise to keep a certain distance from claims of transparency of meaning, unity or rationality in scientific programmes. Instead of grand syntheses of all natural knowledge, what prevails today is an admission of the underlying ontological complexity of the world, the disorder of things about which Dupre speaks (1993: 7). The book by Gibbons et al. (1994) shared this feeling of detachment and expressed, in a managerial idiom, a strong shift in the perception, understanding and handling of scientific and technical knowledge. Its aim was to highlight a change in the way knowledge is produced today across a wide range of scientific and technological scholarly activity. In so doing it touched briefly on some of the issues that have become important in recent debates of the sociology, history and philosophy of science. Its main target was the socio-cognitive organisation of disciplinary knowledge, which the authors called Mode 1 of knowledge production, and the institutional implications of current cognitive transformations, which they subsumed under the rubric of Mode 2. In this article I will comment on some of these aspects in connection with their relevance for debates in developing countries.

From Scientific Knowledge to Scientific Practices

The exercise by Gibbons et al. (1994) rested on recent studies of scientific practice that integrated theoretical content, laboratory

Hebe Vessuri is Head, Department of Science Studies, Venezuelan Institute of Scientific Research (IVIC), Apartado 21827, Caracas, Venezuela 1020A; e-mail: hvessuri@reacciun.ve.

Science, Technology & Society 5: 2 (2000)
SAGE PUBLICATIONS NEW DELHI/THOUSAND OAKS/LONDON

practice materials and instrumentation, with the social and political context that shapes science. The bibliographic references of their work reflect this familiarity with the literature produced in the field of science studies. For the last thirty years science studies have grown into a movement or approach that has increasingly espoused the distributed nature of knowledge and information, and has lent much of its attention to scientific competitiveness, cooperation and networking. This movement dismisses questions of rationalism, method or demarcation, and focuses on the multifaceted details of scientific practice—a practice that consumes the lives of many and affects the lives of all. In this sense, it may be said then that Gibbons et al. are not innovating in their criticism of established science; although this does not diminish the worth of their enterprise.

The Heyday of Disciplinary Science

All along the nineteenth century and during the first half of the twentieth the unity of science and its privileged position vis-à-vis other forms of knowledge went largely undisputed. The cognitive dynamic of science and its social organisation converged in the creation of pure, basic, fundamental, academic, science, through the constitution of scientific disciplines and the modalities of production, diffusion and legitimisation of scientific knowledge that became standard (Vessuri 1992: 156–62). Applied science, that is, theoretical and experimental research aimed at solving concrete technical problems, also evolved in the nineteenth century as a characteristic form of interaction between scientific and technological development. However, the growing significance of science to technology was not perceived as the result of a demand from technology for the scientific solution of problems, but rather as the result of the availability of new techniques ensuing from the autonomous development of theoretical science. This was how scientists tried to protect the recently achieved professional autonomy of their disciplines against the demand of having to produce a science oriented to technical applications.

A crucial element in the institutionalisation of scientific disciplines and their differentiation with respect to other socio-cognitive systems and their competitive relevance criteria has been the development of the social role of research. The institutional framework that completed the differentiation of science through its expression in orderly disciplinary knowledge was the redefinition of the university along the lines of the Humboldtian model. The decisive consequence of the application of idealist principles was the separation of science from its application to life (Vessuri 1992: 160). Science was no longer directly linked to practice but served society only indirectly. The knowledge and practice that Bacon had conceived as a unity became mediated by scientific disciplines that were pursued in the socially autonomous academic context.

What's in an Image?

Images allow us to understand (and misunderstand) the world around us. Today, to some extent, thanks to the growth of science studies, there are available alternative images of scientific practices. 'Scientific' has become an epistemic qualification quite independent of any general consensus about what makes scientific claims any more deserving of credit than beliefs from any other source. The entitlement to this qualification usually derives from the institutional status of the persons from whom the claims originate. There are formal aspects of the products of such institutions that tend to amplify greatly their degree of epistemic prestige (Dupre 1993: 223). The classic or standard image of science is one of homogeneous unification of its different parts under disciplinary umbrellas. Other images, however, have greater currency at present: for example, a more complex and generally more local classification of scientific domains has been proposed in scientific fields with no sharp boundaries between the parts in a network of relationships effected by inter-field theories (Darden and Maull 1977: 44).

There is also the picture of 'crazy-quilt' fragmentation or that of a densely connected map of distinct cultures bound by inter-languages. Galison (1997) expresses concern for the extraordinary variety of scientific languages, practices, purposes and forms of argumentation, and claims that the different subcultures of science do in fact work out local 'trading zones' in which they can coordinate their practices. In his view, 'the knowledge diffusion that takes places is not centralized, and is partial. Chemical engineers share certain common understandings with emulsion physicists; emulsion experimenters share bits and pieces of interpretive strategies with theoretical physicists' (Galison, 1997: 53–54). In his map the limit zones between the various industrial, military, experimental, instrumental and theoretical pieces that make up a knowledge domain have complex and local boundary conditions, in an analogy with the substantive, irregular, boundaries that Sahlins (1989) describes in his book, with the presence of enclaves and intermediate communities, jointly administered sectors, borderland languages and autonomy movements at the margin. None of the available images is perfect. But what the preferred metaphors of today have in common is a narrow focus on the details of scientific experiments and other dealings of researchers rather than, as in the past, on the theories these experiments were supposed to support, attention that has revealed the remarkable particularity of the actual practice of science in specific research programmes drawing on a heterogeneous miscellany of theoretical knowledge, disciplinary and sub-disciplinary cultures, machines, business strategy, photography materials and practices.

Continuous Transformation

Cultures within science differ in a myriad ways. The possibility of working out partial, local and specific linkages seems to underlie the experience of continuity that different groups in scientific practice feel as they elaborate their communicating channels between them. On this view there is no practice cluster—be it theorising, experimenting or building instruments—that is immune to revision, break and radical reconfiguration (Galison 1996: 15). Gibbons et al. (1994) elaborate the idea of communicative interaction in connection with what they call the heterogeneous growth of knowledge, that is, a process of differentiation through which rearrangements of component elements take place within a given process or set of activities. Communication seems to be, in their view, the kind of model or analytical framework that best describes this process of heterogeneous growth, a process of diffusion in which the numbers of linkages between entities increase and new configurations are set up, which dissolve and re-emerge in different combinations. As communication plays a central role in this process, the density of communication appears to be the key variable (Gibbons et al. 1994: 34–35).

Practitioners of the various subcultures, however, do not all move in synchrony. Instead of basing a picture of scientific knowledge on disjoint but internally coherent frameworks, Galison (1996: 15) suggests that we see 'science as a stone wall or rope, composed of disparate and heterogeneous bits, where strength follows just from the circumstance that component parts are not precisely matched, but are interrelated'. Playing the same tune on a different key Gibbons et al. (1994: 35) propose that each new configuration of knowledge itself becomes a potential source of new knowledge production, which in turn is transformed into the site of further possible configurations. The multiplication of the numbers and kinds of configurations are at the core of the diffusion process resulting from the increasing density of communication.

Communicative Interactions and Inter-languages

It is interesting to see that while Galison (1997) emphasises the minimal languages—'pidgins' in his terminology—that are efficacious at interconnecting heterogeneous groups, Gibbons et al. (1994) concentrate on the quantity of communicative interactions of many kinds. In both cases we find the recourse to notions such as 'interstices', 'boundaries', 'languages' and 'hybridisation'. To deal with 'boundary work' Galison (1997) proposes the establishment of 'local languages-pidgins' and Creoles that grow and sometimes die in the interstices between subcultures. In this boundary view of pidgins, exchanges between the subcultures of a scientific discipline and between each of these subcultures and the broader embedding culture are part of the same problem. A kindred attitude to what we find in Gibbons et al. (1994), when they insist that the mixing of norms and values in different segments of society is part of a diffusion process. Such process fosters further communication among segments by creating a common culture and language at the same time that it establishes a variety of inter-systemic agencies or intermediary bodies in the interstices between established institutions or their components. Thus, there is the emergence of new hybrid communities consisting of people who have been socialised in different subsystems, disciplines or working environments, but who subsequently learn different styles of thought, modes of behaviour, knowledge and social competence that they did not originally possess.

The Disestablishment of Science in the Contemporary World

What Gibbons et al. (1994: 4–6) did was to bring home, in a clear-cut fashion, an opposition between what they posed as the traditional but still dominant way of producing knowledge and the new way in which it is supposedly transdisciplinary. Again, other authors have quarrelled with the changes in science before them and have done so in a more systematic way. Once the passive (objective) observer of classical science who discovers, documents or records a world exposed to his or her observation was replaced, in the culture of late-twentieth-century science, by the active, creative and reflexive observer, the earlier boundaries between facts and fictions, or between what is found and what is made, could not be sustained. Reflexive observers are guided by interactive rather than analytical notions of vision. 'Our experiments are not nature itself,' noted Heisenberg (1934: 21 as quoted by Ezrahi 1990: 272), but nature changed and transformed by our activity in the course of research. These changes coincide with the cultural climate of contemporary society, elaborates Ezrahi (1990: 272). Reflexive observers of the social scene tend to be more keenly aware of the theatrical aspect of political actions and of the powers of political actors, including themselves as citizens, to shape the political universe (perceiving this not as a deplorable deviance from political reality but as constitutive of the very reality of politics). The practice of science today, the orientation of scientists and philosophical or historical conceptions of scientific knowledge, expose a paradoxical situation. The increasingly visible rift between scientific and common-sense knowledge, between professional and lay concepts of evidence and proof, has in fact devalued science as a cultural resource for promoting, in the wider social context, respect for the superiority of its claims about the world. The considerations, which are relevant to the confirmation or disconfirmation of scientific claims, are usually inaccessible to the larger public because of their sheer complexity. Even if changes in the knowledge structure of science do not undermine the internal grounds of science and its practice, the theoretical pluralism and the intellectual provisionality that have come to be accepted as legitimate features of the modern scientific enterprise impose serious internal intellectual constraints on the rhetorical force with which scientists can present, in the context of social or political discourse, a uniform concept of reality as superior to all competing concepts.

When dynamic and theoretically conditioned scientific conceptions of the real are construed by lay people as raising doubts about the capacity of science to assure the firmness of the facts of common-sense experience, the social resonance of the greater complexity and remoteness of contemporary science has the effects of weakening the authority of the very images and metaphors that mediated the earlier ideological and political import of science in modern society (Ezrahi 1990). On the other hand, since no sharp distinction between science and (other) lesser forms of knowledge production survives this reoccupation of epistemic merit, we might fairly join Dupre (1993: 243) in saying, if paradoxically, that with the disunity and disestablilshment of science comes a kind of unity of knowledge.

Reshuffling the Institutional Set-up

One of the arguments of Gibbons et al. (1994) is that the change in the mode of production of science (Mode 2) calls into question the adequacy of familiar knowledge-producing institutions, whether universities, government research establishments or corporate laboratories (Mode 1). It is not surprising if institutions are defined as 'carriers' of a particular collective understanding that has consequences of its own, the embodiment of the formulated and communicated outcomes of thought, such as institutional ideologies, roles and functions, the source of legitimation of the groups within them, and the most important source of the financial and political means that help achieve desired aims (Adler 1987: 14–15). In a Weberian sense, institutions become repositories of a constellation of consciousness and collective understanding, which, when integrated into institutional designs, become the preconditions of institutional behaviour. With the change of institutional order, it follows that its strategic or crucial institutional loci are due to change. The strategic knowledge institutions of the twentieth century have been universities, research laboratories, and public and private R&D institutes. On the verge of the new century, the notion and the reality of ever-expanding and constantly reconfiguring institutional networks has captured the collective imagination in the most disparate places (TEP/OECD 1992: 69–87). There is a need to identify national systems of innovation rooted in the system of production and consumption, and part of the broad set of social and political institutions. Universities, research laboratories, and public and private R&D institutes will continue to exist but their relationship with knowledge will be different. At the same time other social institutions will appear with as much significance in connection with knowledge production and distribution, particularly in view of the fantastic growth of knowledge industries (Gibbons 1998).

The Transformed Economic and Political Environment

In the source of change Gibbons et al. (1994) place the altered conditions in the economic and political environment. Those conditions, however, have been modifying themselves since the nineteenth century. A sign of change might be located in the introduction of experimental teaching and research in technical fields through the innovation of the experimental technical laboratory in the second half of the nineteenth century (Holmes 1989). To the extent that the Industrial Revolution deepened its effects, it was with industrial facilities in mind that people began to recognise that institutes of technology ought to take the lead in engineering research (Manegold 1978). First, the recognition of a new status for the *Technique Hoschschulen* (technical schools) and, later on, the installation by industrial firms of their own R&D labs set the stage for the need to transcend the usual scientific and engineering disciplines of the nineteenth century. Either perceived as new disciplines, or, increasingly, as new 'fields', the situation is referred to by some authors as one of a continuum in the search for knowledge, guided by two sets of dominant forces—on one extreme, market forces for goods and services and, on the other, forces linked to the interests and purposes of (still autonomised within academia) professional seekers of knowledge, as a result of which the gap between scientific and technological knowledge began to be filled (Clark 1987).

Closer to the present, two fundamental forces have been responsible for the increasing internationalisation of industry and industrial research: trade and technology. With regard to the first, international trade has changed its nature in the last two decades, principally in view of the strong growth of sophisticated markets in the Pacific Rim and the resurgence of powerful industrial corporations in Europe and Japan to supply the world market. As to the other, there has been a steady process of decline in technical self-sufficiency of technology-based corporations, leading to efforts by corporations to develop access to external sources of technical change (Fusfeld 1994: 118). After World War II foreign direct investment became increasingly important as multinational corporations established their presence in host countries through a variety of forms. The changes in the economic and political environments have also had a deep influence on the social perception of science. Successful development of growth markets at home and in foreign countries requires incessant technical advances. This in turn creates a demand for increased R&D in home laboratories, in foreign laboratories to support market developments abroad or in both. Market opportunities have been so great, competition so intense, and required technical resources so complex and costly that industry has had to make use of other mechanisms, in addition to vast investments in global facilities, to operate effectively on a global scale. The development of linkages to external sources of technology has been implemented internationally by drawing upon the widespread infrastructure set in place by multinational corporations. The substantial participation in world production and trade that this investment represents provided exposure by multinational corporations to opportunities for growth in new markets and a knowledge of the sources of technical change throughout the world that were creating or supplying these markets.

Thus, science is increasingly regarded more as a resource in competitive ventures, such as economic and industrial growth or military conflict, and less as an intrinsically valuable universalistic cultural activity. The 'economic' turn does not end there, however, and there is a deep political implication that only now begins to be digested by society. What is in fact involved is the declining role of science in the rationalisation and legitimisation of public actions. Enlightenment models of public political discourse and action are rapidly dissolving. Science is no longer one of the principal cultural building blocks in the construction of the democratic public realm. The public realm itself is being drastically redefined.

The Negotiated Character of Public Policy Making

The current redefinition of public policy is an attempt to accommodate the newly appreciated complexities of the inherent political components in the contemporary world. The stress on the current connection between science and the context of application, with its implications for 'contextual quality control being exercised as a socially extended process which accommodates many interests in a given application process' (Gibbons et al. 1994: 9–10), reduces science's rhetorical powers to rationalise and validate transpersonal and trans-political norms of public discourse and action. In policy making since the 1960s, 'negotiation' rather than seeking to reach an unequivocally 'best' solution became increasingly recognised to be invariably involved. Policy came to be perceived more as a form of 'pluralistic accommodation' than of rationally directed and managed action sequences. Scientific research begin to lose much of its earlier aura and policy relevance. The bargaining model of government decision making and the perception of bureaucratic agencies as complex political systems, which handle internal conflicts as well as policy issues through compromises and concessions, have gained wide acceptance since the 1960s and have altered the prevailing view of the role of research in the context of policy making.

Future Issues

Some of the implications of this new setting are spelled out by Gibbons et al. (1994: 165) in the form of future issues:

- Increasing diversity will result in the sources of funding for scientific research. A portfolio of identities, disciplinary and transdisciplinary, will have to be managed, without any of them being necessarily pre-eminent.
- The boundaries between private and public knowledge will become increasingly porous. In order to remain viable, national research systems will have to increase permeability, linking up with other systems.
- Advisory systems in distributed knowledge production will become further deconcentrated and diversified.
- The new mode of knowledge production is likely to increase inequality in terms of access and use of the results of S&T activity.

The book ends envisaging a gloomy prospect for the developing world, for despite the fact that 'knowledge production is more globally dispersed, its economic benefits will be disproportionately reappropriated by rich countries and those who are able to participate' in it (Gibbons et al. 1994: 166). This forecast for the developing world was changed into a more positive outlook, not really on development but specifically with regard to the implications for development assistance, in the document prepared for the World Bank as part of that agency's contribution to UNESCO's 1998 World Conference on Higher Education (it may be said in passing that this particular section of the document was provided by a World Bank senior education specialist). The argument in this more recent document is that thinking in the Mode 2 scheme creates opportunities for constructive reflection on prevailing models of assistance for higher education, and may lead to greater effectiveness and responsiveness in development cooperation (Gibbons 1998: 55–57).

Concluding Remarks

I have taken for comment some aspects that Gibbons et al. (1994) mention in their work as ingredients resulting in the changed organisational landscape for knowledge production in the new century. I agree that they have struck a chord that hits hard on the ears of the inherited institutional make-up of the contemporary international science establishment. But since my main concern here is with its implications for developing countries, I would like to conclude by insisting upon the real changes this book signals, and the challenges and risks these new changes pose to the developing world. So universities, and the research laboratories and other related entities often associated with them, have been the key knowledge production institutions in the modern world. I agree with Gibbons (1998: 51) that they have been perceived as 'factories' in which a variety of intellectual capital is employed, enjoying a certain degree of autonomy and 'social distance' for the pursuit of their 'trade-knowledge'. This institutional model of the most advanced nations has been replicated myriad times the world over. The presence of Western-type scientific institutions in the developing world has been widely accepted as an indication of modernity. The institutionalisation of Western science in the developing world proceeded as both an instrument of the interests of the most advanced countries and a result of active attempts by underdeveloped nations to master the knowledge that was the promise of modernity.

But as I have argued in another work (Vessuri 1994: 168–200), this notion, embodied in endless projects of institutions created throughout the modern history of developing countries, has been accompanied by very unequal success and in general by difficulties of consolidation. My conclusion was that scientific institutions were necessary, albeit not to reinforce my conviction that there are no formulas for development. It is neither by building up an institutional set-up modelled after the Western ones, as was expected in the past, nor by urging developing countries, as happens today, to participate in the emerging new distributed knowledge production system expected to support the knowledge industries necessary to sustain international competitiveness that poor countries will manage to achieve.

The largely corporate-based international technical 'network' or 'distributed system' already in place in the world today is basically a combination of internal corporate communications, technical agreements, working relationships and informal technical exchanges. It is a system that provides access to worldwide technical advances in particular fields, developments or markets. Access is not as open as publicised. Rather, it takes place by existing linkage and previous assets. Although it certainly means an opportunity and a challenge for the creative and dynamic management of knowledge, competition is so intense and required resources so complex and costly that countries and institutions within them have to make use of other mechanisms to operate effectively on a global scale. What will be the role for developing countries in the new distributed knowledge production system? Only that of passive consumers of predigested information products? Despite the claims of the advantages of Mode 2 to tackle relevant local problems, what is already happening is that, as a predictable spin-off of the increasing commercialisation of universities in the developing countries, they are introducing their wares to the developing world directly, selling canned virtual courses, consultancy, services of the most varied sorts and research 'solutions' through the redefined schemes of international cooperation. Many institutions of higher education in Latin America become the affiliate, branch or empty cage for new commercial endeavours of the knowledge institutions from the North, ready to explore the last market frontier, that of knowledge.

REFERENCES

ADLER, E. (1987), *The Power of Ideology*. Berkeley: University of California Press.

CLARK, N. (1987), 'Similarities and Differences between Scientific and Technological Paradigms', *Futures*, 19 (1).

DARDEN, L. and N.L. MAULL (1977), 'Interfield Theories', *Philosophy of Science*, 44 (1), pp. 43–64.

DUPRE, J. (1993), *The Disorder of Things: Metaphysical Foundations of the Disunity of Science*. Cambridge, Massachusetts: Harvard University Press.

EZRAHI, Y. (1990), *The Descent of Icarus: Science and the Transformation of Contemporary Democracy*. Cambridge, Massachusetts: Harvard University Press.

FUSFELD, H. (1994), *Industry's Future: Changing Patterns of Industrial Research*. Washington DC: American Chemical Society.

GALISON, P. (1996), *Image & Logic. A Material Culture of Microphysics*. Chicago: The University of Chicago Press.

GALISON, P. (1997), 'Introduction: The Context of Disunity', in P. Galison and D.J. Stump, eds, *The Disunity of Science: Boundaries, Contexts, and Power*. Stanford, California: The University of Stanford Press, pp. 1–33.

GIBBONS, M. (1998), *'Higher Education Relevance in the 21st Century: Education'*. Paper supported by the World Bank as part of its contribution to the UNESCO World Conference on Higher Education, Paris, 5–9 October (published by Human Development Network Education, World Bank).

GIBBONS, M., C. LIMOGES, H. NOWOTNY, S. SCHWARTZMAN, P. SCOTT and M. TROW (1994), *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies*. London: Sage Publications.

HEISENBERG, W. (1934), *Philosophic Problems of Nuclear Science*. London: Faber and Faber.

HOLMES, F.L. (1989), 'The Complementarity of Teaching and Research in Liebig's Laboratory', *Osiris*, 5 (second series), pp. 121–66

MANEGOLD, K.K.H. (1978), 'Technology Academised: Education and Training of the Engineer in the Nineteenth Century', in R. Krohn, E.T. Layton, Jr., and P. Weingart, eds, *The Dynamics of Science and Technology*. Dordrecht: Reidel, pp. 137–58

TEP (The Technology/Economy Programme)/OECD (Organisation for Economic Cooperation and Development) (1992), *Technology and the Economy: The Key Relationship*. Brussels: OECD.

SAHLINS, P. (1989), *Boundaries: The Making of France and Spain in the Pyreness*. Berkeley: University of California Press.

VESSURI, H. (1992). 'Distancias y convergencias en el desarrollo de la ciencia y la technologida', in C.A. Di Prisco and E. Wagner, eds, *Visiones de la Ciencia. Homenaje a Marcel Roche*. Caracas: Monte Avila Editores/Instituto Venezolano de Investigaciones Cientificas, pp. 149–70.

VESSURI, H. (1994), 'The Institutionalization Process', in J.J. Salomon, F.R. Sagasti and C. Sachs-Jeantet, eds, *The Uncertain Quest: Science, Technology and Development*. Tokyo: The United Nations University, pp. 168–200.