Bibliography

Adedeji, A. 1998. African Renaissance, Economic Transformation and the Role of the University. *Indicator South Africa,* **15**(2): 64-70.

Appiah, K.A. 1997. Liberalism and the Plurality of Identity. In Cloete, N., J. Muller, M.W. Makgaba, and D. Ekong (eds), *Knowledge, Identity and Curriculum Transformation in Africa.* Cape Town: Maskew Miller Longman.

Analysis of Research in the Human Sciences (ARHS). 1995. *Social Knowledge for Societal Transformation: Analysis of Research in the Human Sciences.* Pretoria: HSRC.

Arnot, M. 1997. 'Gendered citizenry': New Feminist Perspectives an Education and Citizenship. *British Educational Research Journal,* **23**: 275-295.

Asher, Irvin, Alex Keynan, and Meir Zadok (eds). 1995. *Strategies for the National Support of Basic Research: An International Comparison.* Israel Academy of Sciences and Humanities, Jerusalem. Proceedings of an International Conference sponsored by The Israel Academy of Sciences and Humanities and The Charles H. Revson Foundation, Jerusalem, 23-26 October 1994.

Barnett, S.A. and S. Fuller. 1998. Dialogue Review: Science. *Interdisciplinary Science Reviews*, **23**: 331-339.

Bawa, A. 1997. Knowledge Production and Curriculum Research Strategies in South Africa. In N. Cloete, J. Muller, M.W. Makgoba, and D. Ekong (eds), *Knowledge, Identity and Curriculum Transformation in Africa.* Cape Town: Maskew Miller Longman.

Beck, U.1992. *Risk Society: Towards a New Modernity.* London: Sage.

Bernstein, B. 1996. *Pedagogy, Symbolic Control and Identity: Theory, Research and Critique.* London: Taylor and Francis.

Biggs, J.B. 1991. Approaches to Learning in Secondary and Tertiary Students in Hong Kong: Some Comparative Studies. *Educational Research Journal*, **6**: 27-39.

Boyer, Ernst L. 1990. *Scholarship Reconsidered: Priorities of the Professoriate.* Princeton, New Jersey: Carnegie Foundation for the Advancement of Teaching.

Braskamp, Larry and Jon F. Wergin. 1997. Universities and the New Social Contract. In William G. Tierney (ed), *The Responsive University: Restructuring for High Performance.* Baltimore: Johns Hopkins.

Breier, M.1998. The Role of the Generic Skill in Lifelong Learning; Panacea or Pipe-dream? Mimeo.

Bringle, Robert G, and Julie A. Hatcher. 1996. Implementing Service Learning in Higher Education. *Journal of Higher Education,* **67**(2): 221-239.

Burnham, J. 1997. Evaluating Industry/University Research Linkages. *Research Technology Management,* **40**(1): 52-55.

Carnoy, M. 1993. Multinationals in a Changing World Economy. In M. Camay, M. Castells, S.S. Cohen, and F.H. Cardoso (eds), *The New Global Economy in the Information Age: Reflections on our Changing World.* University Park: Pennsylvania State University Press.

Carr, W. 1993. Education and the World of Work; Clarifying the Contemporary Debate. In J. Wellington (ed), *The Work-Related Curriculum: Challenging the Vocational Imperative.* London; Kogan Page.

Castells, M. 1989. *The Informational City: Information, Technology, Economic Restructuring, and the Urban Regional* Process. Oxford: Blackwells.

Castells, M. 1991. The University System: Engine of Development in the New World Economy. Paper prepared for the World Bank Seminar on *Higher Education and Development,* Kuala Lumpur, July.

Castells, M. 1996. *The Rise of the Network Society: The Information Age: Economy, Society and Culture.* Oxford; Blackwell.

Castells, M.1997. *End of Millennium. Oxford:* Blackwell.

Chomsky, Noam. 1997. Neo-liberalism and Global Order: Doctrine and Reality. Seminar paper presented at the Centre for African Studies, University of Cape Town, 27 May.

Clark, Burton R. 1997a. Common Problems and Adaptive Responses in the Universities of the World: Organizing for Change. *Higher Education Policy*, **10**(3/4): 291-295.

Clark, Burton R. 1997b. The Modern Integration of Research Activities with Teaching and Learning. *Journal of Higher Education,* **68**(3): 241-255.

Clark, Burton R. 1998. *Creating Entrepreneurial Universities: Organizational Pathways of Transformation.* Oxford: Pergamon/Elsevier Science.

Cloete, N., J. Muller, M.W. Makgoba and D. Ekong (eds). 1997. *Knowledge, Identity and Curriculum Transformation in Africa.* Cape Town: Maskew Miller Longman.

Cloete, Nico and Ian Bunting. 2000. *Is Higher Education in South Africa Moving Towards National Transformation Goals?* Pretoria: Centre for Higher Education Transformation.

Cooper, David. 1992. Extension Service Work at University. *Transformation,* **18**:139-148.

Crawford, E. 1984. The *Beginnings of the Nobel Institution. The Science Prizes, 1901-1915*. Cambridge: Cambridge University Press.

Currie, Jan and Janice Newson (eds). 1998. *Universities and Globalisation: Critical Perspectives.* Thousand Oaks and London: Sage.

Currie, Jan and George Subotzky. 1999. Alternative Responses to Globalisation from European and South African Universities. Forthcoming in Nelly Stromquist and Karen Monkman (eds), *Globalisation Forces in* Education. In press: Rowman and Littlefield Publishers.

Currie, Jan and Leslie Vidovich. 1998. Globalisation and Australian Universities: Policies and Practices. Paper presented at the World Congress of Comparative Education, Cape Town 12-17 July.

Darling-Hammond, L.1997. *The Right to Learn.* San Francisco: Jossey-Bass.

De Solla Price, D. J. 1963. *Little Science, Big Science.* New York: Columbia University Press.

Department of Arts, Culture, Science and Technology (DACST). 1996. *White Paper on Science and Technology: Preparing for the Twenty-First Century*. Pretoria: Government Printer.

Department of Education (DoE). 1996. *Green Paper on Higher Education Transformation.* Pretoria: Government Printer.

Department of Education (DoE). 1997. *Education White Paper 3: A Programme for the Transformation of Higher Education.* Government Gazette, Vol. 386, No.18207, Notice 1196 of 1997, July.

Department of Education. 1998. *Higher Education Institutional Plans: An Overview of the First Planning Phase.* Pretoria: Government Printer.

Department of Trade and Industry (DTI), 1998. *Industrial Policy and Programmes in South Africa: Discussion document.* Pretoria: DTI.

Dertouzos, M. L., R.K. Lester and R.M. Solow. 1989. *Made in America: Regaining the Productivity Edge - the MIT Commission on Industrial Productivity.* Boston: MIT Press.

Dill, David D. 1997. Markets and Higher Education: An Introduction. *Higher Education Policy* **10**(3-4):167-185.

Eamon, W. 1985. From the Secrets of Nature to Public Knowledge: The Origins of the Concept of Openness in Science. *Minerva,* **23**(3): 321-347.

Economist. 1990. Giant Science. Editorial, June 9.

Education Policy Unit (EPU), University of the Western Cape. 1997.*The Enhancement of Graduate Programmes and Research Capacity at the Historically Black Universities* (Final Research Report). Bellville, South Africa: EPU (Wits).

Educational Resource and Information Centre (ERIC). 1996. Higher Education and the Public Good. In *Trends: Higher Education and the Public Good.* http://www.gwu.edul/~eriche/library/public.htm

Entwhistle, N. 1998. Approaches to Learning and Forms of Understanding. In Dart, B. and G. Boulton-Lewis (eds), *Teaching and Learning in Higher Education.* Melbourne: Acer.

Etzkowitz, H.1990. The Second Academic Revolution: The Role of the Research University in Economic Development. In S.E. Cozzens, P. Healey, A. Rip, and J. Ziman (eds), *The Research System in Transition.* Dordrecht: Kluwer Academic.

Etzkowitz, H. 1998. The Norms of Entrepreneurial Science: Cognitive Effects of the New University-Industry Linkages. *Research Policy,* **26**(8): 823-833.

Etzkowitz, H. and Loet Leydesdorff. 1995. The Triple Helix: University-Industry-Government Relations. A Laboratory for Knowledge Based Economic Development. *EASST Review*, **14**: 14-19.

Etzkowitz, Henry and Loet Leydesdorff (eds). 1997. *Universities in the Global Knowledge Economy: A Co-Evolution of University-Industry-Government Relations.* London: Cassell Academic.

Etzkowitz, Henry *et al.* 1998. *Capitalizing Knowledge - New Intersections and Industry and* Academia. Albany, N.Y.: State University of New York Press.

Fairweather, James. 1996. *Faculty Work and Public Trust: Restoring the value* of *Teaching and Public Service in American Academic Life*. Needham Heights, MA: Allyn and Bacon.

Finegold, D. and D. Soscice. 1988. The Failure of Training in Britain: Analysis and Prescription. *Oxford Review of Economic Policy,* **4**: 21-53.

Fischer, Stanley. 1998. Lessons from a Crisis. *The Economist,* October. http://www.economist.co.uk/editorial/freeforall/current/sf1142.htm

Foundation for Research and Development (FRD). 1995a. *Announcement* of *New Programmes.* Pretoria: FRD.

Foundation for Research Development (FRD). 1995b. *Strategic Issues in the Development of High-Level Human Resources in Science, Engineering and Technology.* Science and Technology Policy Series. Pretoria: FRD.

Fuller, Steve. 1995. Is there Life for Sociological Theory after the Sociology of Scientific Knowledge? *Sociology*, **29**(1): 159-166.

Fuller, Steve.1997. *Science.* Minneapolis; University of Minnesota Press.

Gardner, H., B. Torff, and T. Hatch.1996. The Age of Innocence Re-considered: Preserving the Best of the Progressive Tradition in Psychology and Education. In D. Olsen and N. Torrance (eds), *Handbook of Education and Human Development. New Models of Learning, Teaching, and Schooling.* Cambridge, Mass.: Blackwell.

Gibbons, Michael. 1998. Higher Education Relevance in the 21st Century. Paper prepared for the UNESCO World Conference on Higher Education, Paris, France, 5-9 October.

Gibbons, Michael, Camille Limoges, Helga Nowotny, Simon Schwartzman, Peter Scott and Martin Trow. 1994. *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies.* California and London: Sage.

Giddens, A .1990. *Consequences* of *Modernity.* Cambridge: Polity Press.

Green, A, 1999. Education and Globalisation in Europe and East Africa: Convergent and Divergent Trends. *Journal of Education Policy,* **14**: 55-71.

Gross, P. R, and N. Levitt.1994. *Higher Superstition: The Academic Left and Its Quarrels with Science.* Baltimore: Johns Hopkins University Press.

Guston, David H. and Kenneth Kenniston. 1994. Updating the Social Contract for Science. *Technology Review,* (Nov./Dec.): 60-68.

Hanlon, Joe. 1998. The World Bank Speech That Knocked Down Every Pillar. *Electronic Mail & Guardian* http://www.mg.co.za/mg/news/98june2/23june-worldbank.htm

Harvey, D.1989. *The Condition of Postmodernity: An Enquiry into the Origins of Cultural Change.* Oxford: Blackwell.

Hellstrom, T. and M. Jacobs. 1999. Evaluating and Managing the Performance of University-Industry Partnerships: From Central Rule to Dynamic Research Networks. *Evaluation,* **5**(3): 334-339.

Henning, Elizabeth. 1998. Service Learning in the University Curriculum: Partnerships in Community Education. *South African Journal of Higher Education,* **12**(1).

Henry, M., R. Lingard, F. Rizvi and S. Taylor. 1997. Globalization, the State and Education Policy Making. In S. Taylor *et al.* (eds), *Educational Policy and the Politics of Change.* London: Routledge.

Hilgartner, Stephen.1997. The Sokal Affair in Context. *Science, Technology & Human Values,* **22** (4): 506 - 522.

Irvine, J. and B.R. Martin. 1984. *Foresight in Science. Picking the Winners.* London: Frances Pinter.

Jansen, Jonathan. 1998. But Our Natives are Different? Race, Knowledge and Power in the Academy. *Social Dynamics,* **24**(2):106-116.

Johnstone, R. 1990. Strategic Policy far Science. In S. Couzzens, P. Healey, A. Rip, and J. Ziman (eds), *The Research System in Transition.* . Dordrecht: Kluwer Academic.

Kaplan, D. 1991. Scarce Resources and Unlimited Needs: Targeting Technology in the New South Africa. In *Proceedings: Technology and Reconstruction Colloquium,* Department of Adult Education and Extra Mural Studies in association with the Development Policy Research Unit, University of Cape Town, May.

Kelley, George. 1998. Does Higher Education Research Need Revisions? *The Review of Higher Education*, **21**(3): 267-278.

Kraak, Andre. 1995. Globalisation, the Learning Society and the Case for a Unified National System of Higher Education in South Africa. Report for Task Group 2: Future Needs and Priorities, NCHE, October.

Kraak, Andre. 1996. Transforming South Africa's Economy; From Racial-Fordism to Neo-Fordism? *Economic and Industrial Democracy*, **17**(1): 39-74.

Kraak, Andre.1997. Globalisation, Changes in Knowledge Production, and the Transformation of Higher Education. In N. Cloete, J. Muller, M.W. Makgoba and D. Ekong (eds), *Knowledge, Identity and Curriculum Transformation in Africa.* Cape Town: Maskew Miller Longman.

Kraak, Andre. 1998. Competing Education and Training Policies: A 'Systemic' versus 'Unit Standards' Approach. Occasional Paper. Pretoria: HSRC. Kraak, Andre and Kathy Wooers. 1995. Investigating New Knowledge Production: A Western Cape Higher Education Case Study. Paper commissioned by Taskgroup 2 of the National Commission on Higher Education of South Africa.

Kuhn, T. S. 1970. *The Structure* of *Scientific Revolutions.* 2nd ed. Chicago: University of Chicago Press.

Locke, R., T. Kochan and M. Piore. 1995. *Employment Relations in a Changing World Economy.* Cambridge, Mass.: MIT Press.

Luckett, Sidney and Kathy Luckett. 1997. Implementing Outcomes-based Education in a South African University. Unpublished paper. University of Natal, Pietermaritzburg, South Africa.

Luke, A. .1998. Miscast Canons? The Future of Universities in an Era of Flexible Specialisation. *Telos,* **111**:15-31.

Magzoub, M. E. M. A. and H. G. Schmidt. 1996. Community-based Programmes: What is Their Impact? *Education for Health,* **9**(2).

Mander, Jerry and Edward Goldsmith (eds). 1996. *The Case against the Global Economy.* San Francisco: Sierra Club Books.

Marais, Hein. 1998. Challenging the Free Market Dogma. *Weekly Mail and Guardian,* http://wn.apc.org/wmail/issues/980925/NEWS54.htm

Martin, Hans-Peter and Harald Schumann. 1997. *The Global Trap: Globalisation and the Assault on Democracy and Prosperity.* Pretoria: HSRC.

Marton, F., G. Dall'alba, and K.T. Lai. 1993. The Paradox of the Chinese Learner. Education Research and Development Unit (RMIT) Occasional Paper, **93**:1-17.

Marullo, S. and B. Edwards. 2000. From Charity to Justice: The Potential of University-Community Collaboration for Social Change. *American Behavioral Scientist,* **43**(5): 895-912.

Matlay, H. and T. Hyland. 1999. Small Firms and the University for Industry: An Appraisal. *Educational Studies,* **25**(3): 253-267.

Maurice, M., F. Sellier and J.J. Silvestre. 1986. *The Social Foundations of Industrial Power.* London: MIT Press.

Melucci, A. 1996. *The Playing Self: Person and Meaning in the Planetary Society.* Cambridge: Cambridge University Press.

Moore, B., B. Leask, P. Leverenz, G. Oliver, A. Reid and M. Rutherford. 1991. *Issues in Australian Studies: People and Power.* Melbourne: MacMillan.

Mouton, Johann. 1998 New Modes of Knowledge Production: The Gibbons Thesis. Paper presented at the seminar *New Modes of Knowledge Production,* sponsored by the Centre for Inter-disciplinary Studies.
Muller, Johan. 1995. *Knowledge and Higher Education.* Report for Taskgroup 2: Future Needs and Priorities. Pretoria: National Commission on Higher Education.
Muller, Johan. 1999. *What Knowledge is* of *Most Worth for the Millennial Citizen?* Paper for presentation at the Conference, *Re-organizing Knowledge, Transforming Institutions: Knowing, Knowledge and the University in the 21st Century,* University of Massachusetts, Amherst September 17-19 1999.
Muller, Johan. Forthcoming. *Reclaiming Knowledge,* London: Falmer.
National Commission on Higher Education (NCHE). 1996. A *Framework for Transformation.* Pretoria: NCHE.
Neave, Guy. 1997. Markets, Higher Education and Social Responsibility. *Higher Education Policy* **10**(3-4):161-162.
Organisation for Economic Co-operation and Development (OECD). 1971. *Science, Growth and Society. A New Perspective.* Report of the Secretary-General's Ad Hoc Group on New Concepts of Science Policy, chaired by Harvey Brooks. Paris: OECD.
Orr, Liesl. 1997. Globalisation and the Universities: Towards the 'Market University'? *Social Dynamics,* **23**(1): 42-64.
Park, S.M. 1996. Research, Teaching and Service: Why Shouldn't Women's Work Count? *Journal of Higher Education,* **68**(1): 46-84.
Parker, Jennifer. 1998. The Politics of Knowledge. Paper presented at the Annual Conference of the Society for the Study of Higher Education, Lancaster, UK, December.
Perold, Helene. 1998. Community Service in Higher Education: Final Report. Johannesburg: Joint Education Trust.
Perold, Helene and Rachmat Omar, 1997. Community Service in Higher Education: A Concept Paper. Johannesburg: Joint Education Trust.
Piore, M. and C. Sabel. 1984. *The Second Industrial Divide: The Possibilities for Prosperity.* New York: Basic Books.
Polanyi, M, 1963. The Potential Theory of Adsorption. Authority in Science has its Uses and its Dangers. *Science,* **141**: 1010-1013.
Polster, Claire and Janice Newson. 1998. Re-claiming our Centre: Towards a Robust Defence of Academic Autonomy. Paper presented at the World Congress of Comparative Education, Cape Town 12-17 July.
Ravetz, J, R. 1992. Three Types of Risk Assessment and the Emergence of Post-Normal Science. In Krimsky, S. and D. Golding (eds), *Social Theories of Risk* Westport: Prager.
Ravjee, Neetha. 1999. New Modes of Knowledge Production; A Review of the Literature. Paper presented at a seminar, Education Policy Unit, UWC.

Reich, R.1992. *The Work of Nations.* New York: Vintage.
Republic of South Africa.1997. *Higher Education Act.* No.101 of 1997.
Rip, Arie. 1982. The Development of Restrictedness in the Sciences. In Norbert Elias, Henminio Martins and Richard Whitley (eds), *Scientific Establishments and Hierarchies.* Dordrecht: Reidel.
Rip, Arie. 1994. The Republic of Science in the 1990s. *Higher Education,* **28**: 3-23.
Rip, Arie. 1997. A Cognitive Approach to Relevance of Science. *Social Science Information,* **36**(4): 615-640.
Rip, Arie. 1998. Postgraduate Training and Research in South Africa: An International Perspective. In *South African Universities' Vice-Chancellors' Association (SAUVCA) Publication Series,* **98**(3): 68-79.
Rip, Arie and Hendrick C. Marais. 1999. Assessing University Research under Conditions of Changing Knowledge Production. *South African Universities' Vice-Chancellors' Association (SAUVCA) Publications Series,* **98**(2).
Robinson, M. and S. Daigle. 1999. Are Universities Ready for Partnerships? *Planning far Higher Education,* **28**(1): 3-9.
Sachs, Jeffrey. 1998. Making It Work. *The Economist,* http://www.economist.com/tfs/archive_tframeset.html
Scott, P. 1995. *The Meanings of Mass Higher Education.* Buckingham: Open University Press.
Scott, P. 1997. Changes in Knowledge Production and Dissemination in the Context of Globalisatian. In N. Cloete, J. Muller, M.W. Makgoba, and D. Ekong (eds), *Knowledge, Identity and Curriculum Transformation in Africa.* Cape Town: Maskew Miller Longman.
Scott, P. 1998. The Postmodern University? In P. Scott (ed), *The Postmodern University?* London: Open University Press.
Shin, T. 1999. Change or Mutation? Reflections on the Foundations of Contemporary Science. *Social Science Information,* **38**:149-176.
Shove, Elizabeth. 2000. Reciprocities and Reputations in Social Science Research. In Merle Jacob and Tomas Heelstrom (eds), *The Future of Knowledge Production in the Academy.* Buckingham, UK: Open University *Press.*
Slaughter, Sheila and Larry L. Leslie. 1997. *Academic Capitalism: Politics, Policies and the Entrepreneurial University.* Baltimore and London: Johns Napkins University Press.
Smith, Robert W. 1989. *The Space Telescope. A Study of NASA, Science, Technology and Politics.* Cambridge: Cambridge University *Press.*
Smyth, John. 1995. A Policy Analysis of Higher Education Reform in Australia in the Context of Globalisation. *Melbourne Studies in Education,* **35**: 39-72.
Stallabrass, J. 1995. Empowering Technology: The Exploration of Cyberspace. *New Left Review,* **211**: 3-32.

Stehr, N.1994. *Knowledge Societies.* London: Sage.
Streeck, W. 1992. *Social Institutions and Economic Performance: Studies of Industrial Relations in Advanced Capitalist Economies.* London: Sage.
Subotzky, George. 1997. Meeting the Dual Demands of Global Competitiveness and Redistributive Development: Constraints and Opportunities for the Historically Black Universities. In N. Bak (ed), *Going for the Gap: Reconstituting the Educational Realm - Kenton 1997.* Cape Town: Juta.
Subotzky, George. 1998a. Beyond Globalisation and the Entrepreneurial University: The Potential Role of South Africa's Historically Disadvantaged Institutions in Meeting the Imperatives of Reconstruction and Development. Paper presented at the World Congress of Comparative Education, Cape Town 12 July. Forthcoming in *International Review of Education.*
Subotzky, George. 1998b. Alternatives to the Entrepreneurial University; New Modes of Knowledge Production in Community Service Programmes. Paper presented at the Annual ASHE-International Conference, Miami, Florida, 4-7 November. *Higher Education,* **38** (4): 401-440.
Subotzky, George, Johan Mouton and Arie Rip. 1998. *The Contribution of Higher Education to Development.' Investigating Modes of Knowledge Production and Developing an Appropriate Research Capacity-Building Model.* Research Project Proposal submitted to South Africa-Netherlands Research Programme for Alternatives in Development (SANPAD).
Task Force on Science Policy. 1987. Science Policy Study, Background Report No. 4, *World Inventory of 'Big Science' Research Instruments and Facilities,* US Government Printing Once, Washington, D.C., USA. Report prepared by the Congressional Research Service (Library of Congress), transmitted to the Task Force on Science Policy, Committee on Science and Technology, U.S. House of Representatives, Ninety-ninth Congress, Second Session, Serial DD.
Taylor, N. and P. Vinjevold. 1999. *Getting Learning Right: The Report of the President's Education Initiative Research Project.* Johannesburg; Joint Education Trust.
Terenzini, Patrick. 199b. Rediscovering Roots: Public Policy and Higher Education Research. *Review of Higher Education,* 2U(1): 5-13.
Tierney, William G. (ed). 1997. *The Responsive University: Restructuring for High Performance.* Baltimore: Johns Napkins University Press.
Tierney, William. G. and Ken Kempner (eds.)1997. *The Social Role of Higher Education.* New York and London: Garland.
Toulmin, S. 1990. *Cosmopolis*. *The Hidden Agenda of Modernity.* Chicago; University of Chicago Press.
University of the Western Cape (UWC). 1995. *Preparing for the Twenty-First Century: Higher Education in a Future South Africa.* A submission to the NCHE on behalf of the University of the Western Cape, September.

Van der Meulen, Barend and A. Rip. 1998. Mediation in the Dutch Science System. *Research Policy*, **27**(8): 757-769.
Van Lente, H. and A. Rip. 1998. Expectations in Technological Developments: An Example of Prospective Structures to be Filled in by Agency. In Cornelis Disco and Barend van der Meulen (eds.), *Getting New Technologies Together. Studies in Making Sociotechnical Order.* Berlin and New York: Walter de Gruyter.
Vorster, S, and P. Nel. 1995. Tracing Power Relations in the Global Knowledge Structure: Two Case Studies. *Politikon*, **21.**
Walshok, M. L. 1996. *Knowledge Without Boundaries: What America's Research Universities can do for the Economy, the Workplace, and the Community.* San Francisco: Jossey-Bass.
Ward, Kelly and Lisa Wolf Wendel. 1997. A Discourse Analysis of Community-Based Learning: Moving from 'I' to 'We'. Paper presented at the Annual Conference of the Association for the Study of Higher Education, Albuquerque, New Mexico, November.
Weekly Mail and Guardian. 1999. Supplement on Innovation. September 10.
Weinberg, A.1961. Impact of Large-Scale Science on the US. *Science,* **134**:164.
Weingart, Peter. 1997. From 'Finalisation' to 'Mode 2': Old Wine in New Bottles? *Social Science information,* **36**(4): 591-613.
Wexler, P. 1990. Citizenship in the Semiotic Society. In B.S. Turner (ed), *Theories of Modernity and Postmodernity.* London: Sage.
Wexler, P. 1996. *Holy Sparks: Social Theory, Education and Religion.* New York: St. Martins.
Wolpe, Harold. 1995. The Debate on University Transformation in South Africa: The Case of the Western Cape. *Comparative Education,* **31**(2).
Young, M. 1999. Knowledge, Learning and the Curriculum of the Future? Inaugural Lecture, Institute of Education, University of London, London, 4 February.
Ziman, J. 1994. *Prometheus Bound: Science in a Dynamic Steady State.* Cambridge: Cambridge University Press.
Zizek, S.1999. 'You may!': The World Turned Back to Front. *London Review of Books Online,* **21**(6), >http://www.lrb.co.uk/v21/n06/Zize2106.htm<

APPENDIX
SOME ATTRIBUTES OF KNOWLEDGE PRODUCTION IN MODE 2

Michael Gibbons

Mode 2 knowledge production can be described in terms of a number of attributes which can be used analytically to specify -the principal differences between Mode 1 and Mode 2. In Mode 2, knowledge is produced in the context of application. It is trans-disciplinary, involves a variety of different skills in problem-solving and utilises more flexible organisational structures. Mode 2 knowledge production is more socially accountable and makes use of a wider range of expertise in its quality control processes. Let us look at each of these attributes in turn.

Knowledge produced in the context of application

The relevant contrast here is between problem-solving which is carried out following the codes of practice relevant to a particular discipline and problem-solving which is organised around a particular application. In the former, the context is defined in relation to the cognitive and social norms that govern basic research or academic science. Latterly, this has tended to imply knowledge production carried out in the absence of some practical goal. In Mode 2, by contrast, knowledge results from a broader range of considerations. Such knowledge is intended to be useful to someone - whether in industry, government, or society more generally - and this imperative is present from the beginning. Thus, knowledge is always produced under an aspect of continuous negotiation - that

is, it will not be produced unless and until the interests of the various actors are included. Such is the context of application.

Application in this sense is not equivalent to product development carried out for industry, and the processes that operate to determine what knowledge is produced are much broader than is normally implied when one speaks about taking ideas to the market place. In the context of application, users and producers of knowledge meet to articulate their various needs and requirements. As knowledge producers arise in a variety of institutions, so users of specialised knowledge come from many quarters, including industry, government departments and voluntary sector organisations. The context of application provides the framework within which users and producers of knowledge work out research programmes and mobilise resources for their execution.

Trans-disciplinarity

Mode 2 does more than assemble a diverse range of specialists to work in teams on problems in a complex applications-oriented environment. To qualify as a specific form of knowledge production it is essential that inquiry be guided by specifiable consensus as to appropriate cognitive and social practice. In Mode 2, the consensus is conditioned by the context of application and evolves with it. The determinants of a potential solution involve the integration of different skills in a framework of action but the consensus may be only temporary depending on how well it conforms to the requirements set by the specific context of application. In Mode 2 the shape of the final solution will normally be beyond that of any single contributing discipline. It will be trans-disciplinary.

Trans-disciplinarity has four distinct features:

> It develops a distinct but evolving framework to guide problem-solving efforts. This is generated and sustained in the context of application, and not developed first and then applied to that context later by a different group of practitioners. The solution does not arise solely, or even mainly, from the application of knowledge that already exists. Although elements of existing knowledge must have entered into it, genuine creativity is involved and the theoretical consensus, once attained cannot easily be reduced to disciplinary parts.

Because the solution comprises both empirical and theoretical components it is undeniably a contribution to knowledge, though not necessarily disciplinary knowledge. Though it has emerged from a particular context of application, trans-disciplinary knowledge develops its own distinct theoretical structures, research methods, and modes of practice, though they may not be located on the prevalent disciplinary map. The effort is cumulative, though the accumulation may travel in a number of different directions after a major problem has been solved.

Unlike Mode 1, where results are communicated through institutional channels, the results of Mode 2 knowledge production are communicated to those who have participated as they participate. So, in a sense, the diffusion of the results is initially accomplished in the process of their production. Subsequent diffusion occurs primarily as the original practitioners move to new problem contexts, rather than through reporting results in professional journals or at conferences. Communication links are maintained partly through formal and partly through informal channels.

Trans-disciplinarity is dynamic. It is problem-solving capability on the move. A particular solution can become the cognitive site from which further advances can be made, but where this knowledge will be used next and how it will develop are as difficult to predict as are the possible applications that might arise from discipline-based research. Mode 2 is marked especially but not exclusively by the ever closer interaction of knowledge production with a succession of problem contexts. Even though problem contexts are transient, and problem solvers highly mobile, communication networks tend to persist and the knowledge contained in them is available to enter into further configurations.

Good examples of trans-disciplinarity in the context of application can be seen in the development of a new computer architecture. In these cases a diverse set of skill is required, including solid state physics, software engineering, linguistics, psychology, physics, philosophy and, of course, computer scientists. They aim to produce knowledge which will be of use. These experts come together in what has been referred to as a context of application because they are challenged by the problem of the next generation of computer architecture and because they know that whatever the solution found, the next but one generation will begin from it. In a sense they can't afford to be left out of the conversation. Further, such architectures are not the result of developing theory first and applying it later. Rather, theory must in some sense be as much the outcome of a successfully working new computer as an input to its design. In the case of novel computer architectures, some maintain that the theory, the design configuration and the relevant software are so intertwined that they emerge at the same time, rather like a new aeroplane which rolls out of a hangar accompanied by a flight simulator precise enough to train the pilots. It is simply too complex to design the aeroplane first and then build a simulator based primarily upon flight test information.

Heterogeneity and organisational diversity

Mode 2 knowledge production is heterogeneous in terms of the skills and experience people bring to it. The composition of a problem-solving team changes over time as requirements evolve. This is not planned or co-ordinated by any central body. As with Mode 1, challenging problems emerge, if not randomly, then in a way which makes their anticipation very difficult. Accordingly, Mode 2 is marked by:

> an increase in the number of potential sites where knowledge can be created - no longer only universities and colleges, but also non-university institutes, research centres, government agencies, industrial laboratories, think tanks, consultancies, and their interaction;

- the linking together of sites in a variety of ways - electronically, organisationally, socially, informally - through functioning networks of communication;
- the simultaneous differentiation at these sites of fields and areas of study into finer and finer specialities. The recombination and reconfiguration of these sub-fields form the bases for new forms of useful knowledge. Over time, knowledge production moves increasingly away from traditional disciplinary activity into new societal contexts.

In Mode 2, flexibility and response time are the crucial factors, and because of this the types of organisation used to tackle these problems may vary greatly. New forms of organisation have emerged to accommodate the changing and transitory nature of the problems Mode 2 addresses. Characteristically, in Mode 2 research groups are less firmly institutionalised; people come together in temporary work teams and networks which dissolve when a problem is solved or redefined. Members may then reassemble in different groups involving different people, often in different loci, around different problems. The experience gathered in this process creates a competence which becomes highly valued and which is transferred to new contexts. Though problems may be transient and groups short-lived, the organisation and communication patterns persist as a matrix from which further groups and networks, dedicated to different problems, will be formed. Mode 2 knowledge is thus created in a great variety of organisations and institutions, including multinational firms, network firms, small hi-tech firms based on a particular technology, government institutions, research universities, laboratories and institutes as well as national and international research programmes. In such environments the patterns of funding exhibit a similar diversity, being assembled from a variety of organisations with a diverse range of requirements and expectations which, in turn, enter into the context of application.

Social accountability and reflexivity

In recent years, growing public concern about issues to do with the environment, health, communications, privacy, procreation, and so forth, have had the effect of stimulating the growth of knowledge production in Mode 2. Growing awareness about the variety of ways in which advances in science and technology can affect the public interest has increased the number of groups who wish to influence the outcome of the research process. This is reflected in the varied composition of the research teams. Social scientists work alongside natural scientists, engineers, lawyers and businessmen because the nature of the problems requires it. Social accountability permeates the whole knowledge production process. It is reflected not only in the interpretation and diffusion of results. but also in the definition of the problem and the setting of research priorities. An expanding number of interest groups are demanding representation in the setting of the policy agenda as well as in the subsequent decision-making process. In Mode 2, sensitivity to the impact of the research is built in from the start. It forms part of the context of application.

Contrary to what one might expect, working in the context of application, increases the sensitivity of scientists and technologists to the broader implications of what they are doing, Operating in Mode 2 makes all participants more reflexive. This is because the issues which forward the development of Mode 2 research cannot be specified in scientific and technical terms alone. Research towards the resolution of these types of problems has to incorporate options for the implementation of the solutions, and these are bound to touch the values and preferences of different individuals and groups which have been seen traditionally as outside of the scientific and technological system. They can now become active agents in the definition and solution of problems as well as in the evaluation of performance. This is expressed partly in terms of the need far greater social accountability, but it also means that the individuals themselves cannot function effectively without reflecting - trying to operate from the standpoint of - all the actors involved. The deepening of understanding that this brings, in turn, has an effect on what is considered worthwhile, hence on the

structure of the research itself. Reflection of the values implied in human aspirations and projects has been a traditional concern of the humanities. As reflexivity within the research process spreads, the humanities, too, are experiencing an increased demand for the sorts of knowledge they have to offer.
Some effects of reflexivity and enhanced social accountability can be seen in the outcomes of various forums for the expression of public concern. Of particular interest is the role played by public controversies. These create meeting places for discussion. Because many diverse actors are involved these meeting places can be regarded as hybrid forums. Controversies frequently lead to the establishment of inquiries dealing with questions of public policy, regulation and a host of other social and ethical issues. New knowledge is gathered, some of it based on the results of previous scientific research and technological developments that have gradually become the cause of social concern. For example, new forms of knowledge such as risk analysis, technology assessment, and the growth of various specialities in environmental science are responses to public concern about the safety of high-risk buildings, the adverse effects of automobile traffic or the effects of global warming. Through these controversies, markets for alternate technologies are developed and foci for new research agendas established.

Quality control

Criteria to assess the quality of the work and the teams which carry out research in Mode 2 differ from those of more traditional, disciplinary science. Quality in Mode 1 is determined essentially through peer review judgements about the contributions made by individuals. Control is maintained by careful selection of those judged competent to act as peers, which is in part determined by their previous contributions to their discipline. So, the peer review process is one in which quality and control mutually reinforce one another. It has both cognitive and social dimensions, in that there is professional control over what problems and techniques are deemed important, as well as who is qualified to pursue in their solution. In

disciplinary science, peer review operates to channel individuals to work on problems judged to be central to the advance of the discipline. These problems are defined largely in terms of criteria which reflect the intellectual interests and preoccupations of the discipline and its gatekeepers.
In Mode 2 additional criteria are added through the context of application, which now incorporates a diverse range of intellectual, social, economic and political interests. To the criterion of intellectual interest and its interaction, further questions are posed: Will the solution, if found, be competitive in the market? Will it be cost effective? Will it be socially acceptable? Quality is determined by a wider set of criteria that reflects the broadening social composition of the review system. This implies that 'good science' is more difficult to determine. Since it is no longer limited strictly to the judgements of disciplinary peers, the fear is that control will be weaker and result in lower quality work. Although the quality control process in Mode 2 is more broadly based, it does not follow that because a wider range of expertise is brought to bear on a problem that it will necessarily be of lower quality. Rather, it is of a more composite, multidimensional kind.