The Triple Helix and New Production of Knowledge: Prepackaged Thinking on Science and Technology

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COMMENT

ABSTRACT This comment considers the approaches expressed in the books by Gibbons et al., The New Production of Knowledge (1994) and Nowotny et al., Re-Thinking Science (2001), and in the body of work pioneered over the last few years by Henry Etzkowitz and Loet Leydesdorff which expounds the ‘Triple Helix’ analysis of industry/university/government relations. Citation analyses and Internet search data are used to explore the geographical locations, audiences and ‘impact’ of this work. The strengths and weaknesses of these approaches are discussed, and the challenge of ensuring that they become more than fleeting fads, nourishing an unproductive frenzy, but develop so as to contribute something enduring to scholarship and practice.

Keywords citations, dynamics of research, endless transition, industry/university/government relations, innovation, Mode 1, Mode 2, policy, socially robust knowledge

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Terry Shinn

Assertive demands, originating in government and to a lesser extent in industry, for readjustments in science/enterprise/state relations were set in motion by the energy crises of the 1970s and again, by the economic slumps of the 1980s and early 1990s. Science and technology were bannered as a solution to over-dependence on foreign energy supplies, and a panacea to economic sluggishness and sharply rising unemployment. Sociologists, economists, political scientists and science policy makers have responded to the ensuing emergence of a new set of political, industrial and social expectations, discourses and projects in a variety of ways. One reaction has consisted of studies of the interplay between research, business and the government, and suggestions of conceptual frameworks to explain the observed changes. Other scholars have proposed a blueprint for...
transformation, and have become partisan activists in the promotion of change. Both these reactions have their place within the confines of particular cognitive and social fields.

This comment will explore this reaction with reference to the fields associated with the Triple Helix and the New Production of Knowledge. *The New Production of Knowledge*, published in 1994 and authored by Michael Gibbons, Camille Limoges, Helga Nowotny, Simon Schwartzman, Peter Scott and Martin Trow, argues that the way in which scientific knowledge, technical practices, industry, education and society at large are organized and function today lies in sharp contrast with the relationships in earlier times. The authors speak of two distinct modes of knowledge production. ‘Mode 1’ is characterized by a cleavage between academia and society. Academia revolves around an autonomous university, self-defined and self-sustained scientific disciplines and specialties, and the determination by scientific peers of what does and does not constitute science and truth. Here there is allegedly no interaction between academia and industry. By contrast, ‘Mode 2’ knowledge production perceives the weakening or collapse of the modern university, the disappearance of scientific disciplines and the atrophy of peer control over the direction and content of research programmes. ‘Mode 2’ science is characterized by interdisciplinarity, by the fluent movement of short-term task-force teams of experts to problem domains, and by the primacy of social and economic problems in establishing what spheres of knowledge should be developed. Society thus denies the legitimacy of science’s prerogatives, its institutional autonomy and cultural identity.

By contrast, the Triple Helix stresses historical continuities. Earlier relations between the university, industry and government persist. But to these models of learning and action is now added another, which has been called the ‘Triple Helix’. Unlike the New Production of Knowledge, the Triple Helix does not possess a charter document in the form of a single extremely visible book which can readily be cited. Rather than repudiating institutional differentiations, this perspective identifies the birth of a supplementary layer of ‘knowledge development’, a layer in which specific groups inside academia, enterprise and the government meet in order to address new problems arising in a deeply changing economic, institutional and intellectual world. The Triple Helix is intended to be a sociological expression of what has become an increasingly knowledge-based social order.

These two perspectives prompt five questions. Questions one and two are reflexive: First, how much attention has each perspective received? Second, who actually ‘use’ these two perspectives? What national, institutional and disciplinary rôles do they play? Stated differently, and using the language of Pierre Bourdieu, what is the structure of their socio-cognitive field? By ‘socio-cognitive field’ is meant the interdependencies between the historical, institutional and political elements structurally integral to knowledge, and the rational and rhetorical components that are equally determinant. A ‘socio-cognitive field’ is a domain where cognitive and
social elements are simultaneously self-referencing and combinatory as they interact to form a whole. Third, what are the characteristics of the claims, data, methodology and theory of the two perspectives? Are their profiles similar, or do they operate in different intellectual and institutional socio-cognitive fields? Fourth, what changes of analysis, diagnosis or prognosis (if any) have occurred in these two perspectives over the last several years? Lastly, what are the domains of internal inconsistency, inadequacy or malfunction of each approach?

A Pinch of Reflexivity

Sociologists of science and technology routinely do bibliometric studies of scientists working in the physical and life sciences in order to learn about the productivity of a research school, about those who occupy it, and those who constitute its audiences. To examine the ‘impact’ of the Triple Helix and the New Production of Knowledge, and the institutional loci of the people who incorporate these perspectives (or at least who refer to them), I have drawn on the Social Science Citation Index™ for the period 1995 to 2000, as well as information available on the Internet. An exact comparison of the two encounters serious methodological snags, so the picture that I present is an approximation, although I believe it is sufficiently rigorous to suggest important differences between the two communities.

The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies constitutes a charter document and a group manifesto. A second treatise, Re-Thinking Science, by Helga Nowotny, Michael Gibbons and Peter Scott, has recently appeared. For my study, I limited quantitative tabulations to references made to the first book, by Gibbons et al. For the period 1995 to June 1999, a total of 98 references were made to the book: 1995 (8), 1996 (16), 1997 (15), 1998 (30), 1999 (29). The number of references for the first six months of 1999 already equals those for 1998; the total (not including self-citations) from 1995 to July 2002 is 266 citations. The citing journals include sociology, the sociology of science and technology, science policy, psychology, social psychology, and education. References in education reviews are particularly abundant. Indeed, both the quantity and range of citations to the New Production of Knowledge are impressive.

By contrast to the New Production of Knowledge, the Triple Helix does not possess a charter document. This suggests an important structural difference between the two socio-cognitive fields. The Triple Helix has emerged gradually, and its textual architecture takes the form of numerous interlocking pieces, such as introductions and conclusions of collective works, chapters, articles or unpublished conference papers. To make my bibliometric task more manageable, I tabulated the references made to six defining or descriptive empirical or theoretical pieces published by Loet Leydesdorff or/and Henry Etzkowitz (the founders of the Triple Helix perspective) between 1995 and 1998; and to the pieces published in two
collective volumes edited by Leydesdorff and Etzkowitz in 1997 and 1998.\textsuperscript{6}

As measured by the Social Science Citation Index\textsuperscript{TM}, the impact of the Triple Helix perspective is negligible – almost non-existent. For the period 1996 to mid-1999, I found only one reference to the extensive corpus to which I extended my bibliometric search; from 1995 to July 2002 (including the Research Policy [2000] Special Issue), the total (excluding self-citations) is 35 citations. I also examined the place occupied by the two perspectives on Internet, where the story is rather similar. Using the altavista.com search engine, I discovered about 30 web pages referring to the combined word sequences ‘New Production of Knowledge’ and ‘Mode 2’. The theme of education is again paramount; for example, in relation to designing the ‘new’ university, the ‘cyber-university’, and so on. However, New Production of Knowledge web sites even extend to psychoanalysis of organizations!\textsuperscript{7} On the Internet, this perspective is a good example of the ‘bandwagon’ effect, as individuals and groups from a variety of disciplines and occupations jump aboard. Apparently, the terminology (New Production of Knowledge) resonates in a number of areas, where it can be seen to engender a community, whose shared feature consists of invoking a set of words. Whether the shared vocabulary is rooted in structured concepts or is merely a felicitous phrase remains to be seen. Durkheim demonstrated the power of metaphors and their centrality to sociology, but is the New Production of Knowledge a metaphor, or just a catch phrase?\textsuperscript{8}

The Triple Helix is not prominent in either the Social Science Citation Index\textsuperscript{TM} or the Internet. On the basis of the search engine COPERNIC, I have identified eight sites.\textsuperscript{9} These include information on the three international Triple Helix conferences (Amsterdam, 1996; New York, 1998; and Rio de Janeiro, 2000), as well as a general purpose information site and discussions forum. These sites appear to be updated and reasonably active. Of course, as everyone knows, the Internet is a place for selfpromotion, so it must be treated with caution as an impact indicator. The hand of Loet Leydesdorff is discernible in most of these sites, and this contrasts with the New Production of Knowledge sites where the authors of the seminal book appear to play only a marginal rôle.

How is it that the impact indicators of the Triple Helix remain so low, both in the Social Science Citation Index\textsuperscript{TM} and on the Internet? What does this mean? How does the low impact indicator for the Triple Helix square with the reality that its analytical focus has spawned three large international conferences, triggered scores of articles, and raised considerable amounts of public and private money? Immediately, the modest impact indicator in the Social Science Citation Index\textsuperscript{TM} and on the Internet suggests that there are reasons to rethink the relationship between the growth of ideas and reputations, on the one hand, and what citation counts tell us, on the other. Indeed, what, if anything, do citation counts tell us about the precision, rigour and documentation of claims? In the social sciences, abundant citation may be a better gauge of evocative language, speculation
and far-reaching generalization than of prudent measurement or careful hypothesis testing.

The geographic composition of the communities drawing upon the Triple Helix and the New Production of Knowledge also differs significantly. The geographic distribution of the Triple Helix audience is very broad, and includes large numbers from Latin America, Asia and Africa. On the other hand, the New Production of Knowledge audience is concentrated in Western Europe and the United States and Canada. Based on the institutional affiliations of citing authors and individuals attending relevant meetings, over 90 percent of the New Production of Knowledge audience is based in the North, as against about 65 percent of the Triple Helix (the latter count is based on participation in conferences). The Triple Helix thus enjoys a sizable following among the developing countries. As we shall see, there are clear-cut reasons for this.

Methods, Claims and Concepts

The intellectual structures of the Triple Helix and the New Production of Knowledge differ significantly. The nucleus of the New Production of Knowledge is located in a single volume, in which are expressed claims about the demise of universities, scientific disciplines and academic laboratories; and a rise in interdisciplinarity, economically and socially-relevant research themes, and the appearance of perpetually fluid business-linked research task-forces, in the framework of a new kind of socially useful epistemology. The book may in this sense be read as a compact and articulate charter that reflects the interests of scholars and others concerned with global business, learning and social relations.

The reader is struck by three features. The New Production of Knowledge raises few questions about the evolution of science and technology, or about changes in their relations with enterprise and society. Instead, it offers a number of prefabricated indications about where science has putatively come from and where it is allegedly going. No questions, but lots of answers. On a parallel plane, almost no concrete evidence is given for the assertions advanced; and no provision is made for future empirical, historical or sociological work. While the absence of data in the book is distressing, people interested in this approach and desiring to explore its possibilities might hope for precise information in subsequent works. However, this hope has so far not been realized: the six authors have not embarked on confirming empirical projects; neither have colleagues come up with corroborating data.

The perspective’s empirical underdevelopment is particularly regrettable, for one can easily imagine that its tenets could prove highly instructive for the study of a series of important but little explored domains – such as the fluid and multi-determinant relations of knowledge orientation, production, application and evaluation in/for communities of the physically handicapped or ill. But to my knowledge, research along these lines has not been inspired by the New Production of Knowledge. Moreover, the
systematic empirical work that has been carried out with reference to
the *New Production of Knowledge* (perhaps in fields less conducive to its
predictions), has, by and large, suggested that the claims run counter to
available evidence, or that the claims are at best not clearly validated by
available facts. In short, there appears at present to be a paucity of careful
control studies in selected spheres to identify the strengths and limiting
conditions of the sweeping generalizations expressed in the book. The book
lacks the methodological motor that is necessary to drive any research
programme forward.

These programmatic and methodological difficulties may be a con-
sequence of the fact that the approach lacks a theoretical referent. It is not
specifically connected to any conceptual framework – for example, to that
of Durkheim, Weber, Parsons, Bourdieu, Habermas or Luhmann. The
*New Production of Knowledge* does not work out or define its key socio-
logical concepts. One is tempted to ask, does it possess any? The answer is
complicated. It does incorporate concepts, but whether the concepts are
rigorously sociological is doubtful.

That said, the approach is ‘anti-differentiationist’, as it seeks to mini-
mize or to deny demarcations between academic, technical, industrial,
political and social institutions. It thus dismisses boundaries and divisions
of labour. The perspective rejects the notions of specific forms of knowl-
edge and specific social constituents in favour of undifferentiated
knowledge and undifferentiated social ensembles, where even the distinc-
tions between nature and culture disappear.

However, this radical anti-differentiation line is never buttressed with
sociological theory, concepts or models. Instead, it stands as a free-
floating, unintegrated component. This situation is permissible if the
perspective is interpreted, not as a sociological research programme linked
to the study of the production, diffusion and use of knowledge, but instead
as a performative discourse. This postmodernist penchant is coupled with
what appears to be a muted preference for globalization. Instead of theory
or data, the New Production of Knowledge – both book and concept –
seems tinged with political commitment. The authors appear to be true
believers in a new cognitive and social order. They work actively in its
favour and seek to persuade others to think likewise. One has to wonder if
the perspective is not more a social platform than a serious, systematic
framework for scholarly inquiry.

Of course, ambitious ventures involve a measure of self-promotion and
propaganda. However, a research programme must exhibit a cognitive plan
in addition to a set of professional strategies. The question becomes: what
is the intellectual ‘project’ of the New Production of Knowledge? But, by
the same token, one must ask the same question of the Triple Helix: what is
its intellectual project and agenda?

The horizons of the Triple Helix are four-fold. First, it has developed
an empirical base, in the form of multiple case studies of changing
relations between university, industry and the state. Many of the articles
appearing in the February 2000 issue of *Research Policy* document the
changing relations between the three strands composing the Triple Helix with respect to specific economic sectors and cognitive fields – biotechnology, aeronautics, computers and instrumentation. Implicitly, these studies raise a central question: what is the purview of the Triple Helix? Does it apply only to a narrow range of economic, cognitive, technical and governmental configurations, and, if so, which? The centrality of empirical data goes some way toward neutralizing the normative propensity associated with sociological models. Inclinations towards generalization are in part balanced by analyses of concrete events. As will be shown below, a healthy attention to matters of fact has recently led to some key changes in the model’s focus, prescriptions and conceptual thrust. This structured inclusion of detailed information in the modelling process, and in evaluating the model’s utility, would appear to contrast with the New Production of Knowledge, which remains thin on data and prone to sweeping generalizations.

Second, the Triple Helix explicitly addresses concrete and pressing problems of government, academic and industrial policy. Here, the model’s authors are sometimes involved in stimulating entrepreneurs, university administrators and public figures to rethink policy and conduct, in response to changing cognitive, technical, economic and international trends. The mode of action is not that of a lobby or movement, but rather that of a mindful ‘think-tank’. Additionally, the spate of publications and meetings associated with the Triple Helix helps policy makers keep abreast of changing environments – and, when possible, to anticipate change. This is shown by the involvement of the National Science Foundation, the Centre National de la Recherche Scientifique, NATO, the European Commission, and political and academic authorities in Brazil and other developing countries, in reflection on the Triple Helix.

Often implicitly, and sometimes explicitly, the authors of the Triple Helix ask whether the putatively new arrangements emerging between academia, industry and the state are relevant to the actual process of economic, intellectual and political emergence underway in Latin America, Africa and Asia. Are the institutional realities of developing countries sufficiently similar to those in northern nations (on whose experiences the model is based) to make the Triple Helix analysis relevant? If there is a mismatch, is it possible, or desirable, to use the Triple Helix as a guideline to transformations in university/industry/state relations in order to reinforce processes of emergence? Given the size of the delegations that participated in the Rio conference in April 2000, the hope that this may be true runs high. This aspect of the Triple Helix contrasts with the perspective given by the New Production of Knowledge, which speaks more to institutionally and technologically advanced environments.12

Third, the analytic thrust of the Triple Helix is opposite to that of the New Production of Knowledge, in which distinctions between (or differentiations between) science and technology, industry and academia, society and knowledge are denied. By contrast, the Triple Helix pursues a neodifferentiation strategy.13 Henry Etzkowitz and Loet Leydesdorff argue
that, while throughout much of the 19th and the first half of the 20th century, the related yet distinct strands occupied by the university, industry and state functioned effectively, internal events in each, and changing relations between them, are giving rise to still another differentiated unit – one which fuses the three strands in a historically unique way, the Triple Helix. This emergent entity constitutes a new synthesis between state, academia and enterprise. However, unlike the New Production of Knowledge, this synthesis does not efface previous discontinuities, but rather constitutes an additional, new discontinuity – the Triple Helix (as opposed to three related single helices).

This neo-differentiation perspective generates many questions: Precisely what concrete entities does it comprise? What mechanisms have led to its emergence? What new functions does it perform? How can we know that the Triple Helix is a ‘new’ differentiation, rather than a readjustment that has modified environments without imperiling the established institutions? Are entities like incubators, start-ups, and other new forms of government/enterprise partnerships the deciding examples on which the validity of the Triple Helix depends? This would appear to be an empirical question, although a difficult one!

Fourth, the Triple Helix is accompanied by a theoretical framework that takes the form of self-organization and co-evolutionary theory. The standard references here are Humberto Maturana and Nikolas Luhmann. The key claims of this theory are the following: (1) Under specified conditions, institutional and cognitive structures become ill-adapted to current situations and unstable; (2) Several structures evolve, and this co-evolution generates a historically new institutional and/or cognitive structure; (3) Time constitutes a foundational dimension in this dynamic process; (4) Co-evolutions temporarily resolve problems of mismatches in the complexities of earlier systems; (5) In time, the new layers of complexity are themselves accompanied by fresh mismatches (institutional and/or cognitive), and this breeds further cycles of co-evolutions.

Many interlocutors express unease with the theoretical pronouncements surrounding the Triple Helix, and are even bewildered by them. This may derive in part from difficulties with mathematical formulations associated with the theory. It may also stem from difficulties in penetrating the theory’s insider terminology (expressions such as ‘lockin’ and ‘overlays’). If a theoretical message is being transmitted, it is not intelligible to many in the audience. An incomplete understanding of the theory tied to the Triple Helix potentially hinders a full appreciation of the model and its inherent possibilities. The theoretical message that accompanies the Triple Helix must be made intelligible. If not, the co-evolutionary concept will likely become viewed as irrelevant or wrong, and detached from the empirical, diagnostic and prognostic components of the Triple Helix. The result would be a less ambitious, rather than a strongly predictive model integrated into a general social theory.

The fit between theory and the empirical data constitutes another problem: co-evolution theory describes structures and transformations on
a meta-level and in macroscopic terms. The search for appropriate units of analysis takes place at a high level of aggregation, generalization and abstraction. However, such analytic operations and postulates may not sit comfortably with the rich, interesting and insightful empirical studies promoted by the Triple Helix. Intermediary mechanisms must be specified to link well-established institutional, economic and cognitive changes to the co-evolutionary theory in an unambiguous and corroborative way.

It is fair to ask whether co-evolution constitutes the only or the best theoretical frame for the Triple Helix. Do other systems, such as Durkheim’s functionalism, or Bourdieu’s concepts of ‘field’ and ‘habitus’, provide alternatives? If not, then why? Does the probable objection that alternative systems do not include the time dimension, or do not do so in a systematic fashion, constitute a sufficient argument to lock the Triple Helix to co-evolution?

Sociology versus Introspection

Until recently, the message of the New Production of Knowledge has remained constant. Although some of its authors (Michael Gibbons and Helga Nowotny, in particular) have often spoken in defence of their ideas, nothing new has been forthcoming in print. Fortunately, Nowotny, Gibbons and Scott’s Re-thinking Science (published in 2001) allows us to examine the issue of change in the New Production of Knowledge perspective. What is their message today, and where does it stand with respect to 1994?

Like many, the authors talk about a ‘new contract’ between society and science. They also write about ‘society learning to speak to nature’ – by which they mean the eclipse of the science referent as the basis for scientific legitimacy, and its replacement by a purely social referent. Their book introduces a number of new terms – or, at any rate, existing terms in unfamiliar usage. Many are worthy of further reflection.

1) For example, the authors argue in favour of ‘contextualization’, by which is meant the need to ‘de-differentiate’ between science and society. While Modernity has been characterized by distinctions between nature/culture and science/society, this demarcation, they argue, no longer holds. The postmodern order is to be ‘heterogeneous’, and heterogeneity does not entail differentiations. Heterogeneous audiences address knowledge producers in the ‘agora’.

2) Postmodern society is characterized by ‘reverse communication’ – that is, by communication from society toward knowledge producers, and not vice versa. Society decides on what knowledge is to be. Knowledge producers accept and follow. Knowledge is socially relevant learning, and is generated in fluid relations between the state, markets and industry. Knowledge production is represented as a transition phase operation.

3) ‘Experts’ operate in a framework of ‘socially distributed knowledge’. Learning is no longer set off from society, and the activities of experts
ensure that learning addresses social needs. Successful enterprise in a
global economy constitutes one such paramount need.\textsuperscript{20}

4) The authors of \textit{Re-Thinking Science} insist that the New Production
of Knowledge involves a new epistemology, which they label ‘socially
robust knowledge’. They argue that advances in physical theory have come
to a standstill. Possibilities of fresh conceptualization are exhausted. ‘So-
cially robust knowledge’ refers to scientists’ putative inclination to for-
mulate promising research problems in terms of the ‘novelties’ that they
may engender. ‘Socially robust knowledge’ consists of the systematization
of application-oriented, mission-driven research and learning.\textsuperscript{21} The rig-
ours of relevance become the epistemological yardstick of the New
Production of Knowledge, and its measure will be taken by experts
functioning in the system of socially distributed learning. This, the authors
emphasize, is what is entailed by ‘Mode 2’.

The message conveyed in \textit{Re-Thinking Science} is similar to that ad-
vanced almost a decade ago in \textit{The New Production of Knowledge}. Both point
to the end of disciplinary science, universities, laboratory-rooted research,
and differentiations between scientific knowledge \textit{per se} and society. Both
accord primacy to the social relevance of learning, and, in particular, to the
demands of enterprise. The 1994 book hints at a new epistemology: the
latest book develops the theme and identifies it as a mainstay of Mode 2.
Like the 1994 volume, the latest book is silent when it comes to giving
evidence, or for suggesting directions for research. The book appears to be
mainly a product of introspection and a basis for future reflection.

Finally, one cannot help wondering if \textit{Re-Thinking Science} does not
open the way to, or perhaps even legitimate, a neo-corporatist vision of the
world. By collapsing the specificity and institutional setting of science, of
technology, of industry and of politics, do not Nowotny, Gibbons and
Scott inadvertently lay the foundations of a social amalgam whose direc-
tion and details can be readily imposed by an authoritarian political
force?

This static stance contrasts with the mobile, fluctuating analyses
advanced by the architects of the Triple Helix. At a meeting in June 1998
to compare the Triple Helix and the New Production of Knowledge, I
suggested that the two approaches exhibit a degree of inverse symmetry.
I argued that the New Production of Knowledge constitutes a \textit{radical} ‘anti-
differentiation’ message, and that the Triple Helix constitutes a \textit{radical}
‘neo-differentiation’ message. During the meeting, I asked proponents of
the Triple Helix two questions. First, precisely which institutions and
initiatives embody the allegedly emergent synthetic ‘triple’ strand, as
opposed to the three separate historical strands which compose it? Second,
whatever its exact form, precisely how ‘radically differentiated’ is the
putative ‘neo-differentiation’? No clear-cut answers were forthcoming.
However, I consider that now (some four years later), Etzkowitz and
Leydesdorff have provided replies to my queries. Indeed, perhaps too many
replies for the sake of clarification. Be this as it may, Triple Helix thinking
has evolved considerably since its initial formulation.
In their overview of the Triple Helix appearing in *Research Policy*, Etzkowitz and Leydesdorff give voice to two ideas: 1) The Triple Helix is centred inside the traditional university. Etzkowitz and Leydesdorff insist that discipline-based departments are converging in new ways, and while maintaining traditional lines of research, are also turning to industrial research and intermediary forms of research. Universities are thus generating a variety of midwife institutions that link them to economic and social concerns. The university constitutes a privileged site in which discourses come together, merge and give rise to new forms of discourse and action. In this publication, the highly illusive Triple Helix has at long last been identified.

2) In the same publication comes the term ‘endless transition’. This is an important addition. An emphasis on repeated co-evolutions attenuates the focus on a single landmark. We no longer have to search for ‘a’ single macro-entity which embodies a dramatic three-strand confluence. The model now becomes compatible with much smaller changes and co-evolutions occurring inside one of the three strands. People interested in the Triple Helix approach are now free to search for small variations and variants (endless transitions on a micro-level). This re-ordering within the model in favour of finite and micro-level transitions dovetails with the recent attention given to the changes taking place inside the university strand mentioned above.

So what has the Triple Helix become? According to this overview, the university is sustained. Along with its traditional functions of teaching, certification and fundamental research, recent cognitive and economic changes have merely added new functions. The historical rôle of universities is preserved, and extended to accommodate changing circumstances. Here, the university has been cannily slipped through the back-door as the decisive element in contemporary cognitive and economic dealings. Concomitantly, the novelty of the Triple Helix metaphor discreetly recedes. The disturbing dislocations of the Triple Helix are being supplanted by evolutionary, transitional and incremental adjustments within academia!

However, Etzkowitz and Leydesdorff seem to disagree with this reading. In his keynote address to the third international Triple Helix conference, held at Rio in April 2000, Henry Etzkowitz declared that the Triple Helix is embodied in ‘incubators’. But this claim conflicts with the position taken by himself and Leydesdorff in *Research Policy*. Even greater confusion ensued when Etzkowitz insisted that the Triple Helix is to be found in the ‘second academic revolution’, a stance at least consistent with the *Research Policy* affirmations. But one wonders what kind of thinking underpins such claims. What evidence can be mustered in support of either of the two propositions?

An examination of *sociofile*, and of several Internet search engines, for ‘incubator’ and for ‘second academic revolution’ reveals that little has been written on these topics – indeed, so little, that it is unclear to exactly what (sociologically and cognitively) the two terms refer. Before crediting either
incubators or the second academic revolution with being the cornerstone of the Triple Helix, it is first necessary to determine their cognitive, economic and social properties.

However, if one adopts the ‘Endless Transition’, what is to be made of the formerly revolutionary Triple Helix? Because, if, as admitted by the authors, the key co-evolutions can arise within just one of the three constitutive strands, then the status of the alleged historically new and unique macro-entity (the ‘triple helix’) must provoke reservations. In view of these refinements, can one say that the model still exists, or is it not rather giving way to a new formulation, more in harmony with empirical evidence collected in the course of careful case studies – a formulation which has little to say about ‘radical neo-differentiation’? Whatever its future, the Triple Helix has prompted many to consider how science/government/industry relations have changed, are changing, and are likely to change. This orientation will evolve as it draws on case studies and debate.

Challenges

The size and disciplinary/professional diversity of the audience for the New Production of Knowledge stem in part from the fact that its argument touches on many spheres, extending from education to research, business, politics and the organization of contemporary democracy. Many think of it as a skeleton key, a magic potion, for understanding an array of problems. The New Production of Knowledge is not a research school, since it does not articulate a research programme. The New Production of Knowledge and Re-Thinking Science do not define questions, set forth a methodology, provide reasoned answers, or set limiting conditions. On the contrary, they can be likened to political manifestos, whose expository form is rhetoric.

The socio-cognitive field of the Triple Helix is very different. When measured in citations, its audience is negligible. But if gauged by reference to international meetings and developing nations, the Triple Helix mobilizes a large number of followers. The Triple Helix may or may not constitute an analytic model, but it does constitute a serious research school with an empirical and conceptual agenda.

Both of the approaches can be faulted for failing to take into account two important aspects of knowledge and artefact production and diffusion. The first deficiency lies in their failure to recognize that the university, business and government all function in a national setting. Even scientific disciplines and specialties operate differently in different national institutions, and this is also true for business. This does not diminish the importance of multi-national, trans-national or global phenomena. Globalization is on the rise; but at least at present, the de-nationalization of science is not eclipsing the national component of the organization and work of scientific teaching and research. Evidence abounds that Richard
Nelson’s concept of ‘national systems of innovation’ still accounts for much of science/industry/government dealings. 25

I suggest that we move away from an ‘either/or’ scenario, in which mainly global or mainly national practices and arrangements are emphasized – each to the exclusion of the other. It is clear that a host of changes are sweeping science, industry and government. However, these are being played out in the framework of the nation state. This is the case even in Europe, where, despite serious efforts at a common science and economic policy, there is no decline in national science initiatives. An example of this is the bitter dispute over the design, site and construction of the third generation of cyclotrons – shall it be in England or France? It has been decided that each nation will have its own cyclotrons.

One way of reformulating this issue is to ask: which economic sectors and cognitive fields are most strongly tied to national systems, and which operate outside national constraints? 26 A sociological approach to changing science/industry/state relations should combine concerns expressed in the New Production of Knowledge and the Triple Helix, with schemes that factor in national traditions, laws, employment and career patterns, and national institutions and cultures. To remain silent on these entrenched and enduring particulars is surely misguided.

A second problem facing the two approaches relates to the way in which they deal with one of sociology’s key concepts – namely, ‘differentiation’. The New Production of Knowledge analysis suggests that ‘differentiations’ (and divisions of labour) are a thing of the past. It is a failing that this startling claim is not girded by discussion of how ‘differentiations’ have operated in the past, how and why they have allegedly eroded, and what their putative demise implies for sociological theory. The Triple Helix is equally unhelpful, although from a different point of view. The perspective retains classical concepts of differentiation and integration. But in practice, this simply entails the projection of long-standing cycles of integration, neo-differentiation and neo-integrations through an infinity of co-evolutionary iterations. Regrettably, this contributes little.

Despite their many important differences, the two approaches constitute a shared search for what might best be called ‘transversality’ – transversality that crosses cognitive, technical, economic and societal boundaries. 27 Significantly, neither the New Production of Knowledge nor the Triple Helix has examined the historical record for the existence and actions of communities rooted in transverse actions; instead, they both work under the assumption that transversality is resolutely a functional product of our time and culture. Nevertheless, some recent history and sociology of science and technology suggests that, for almost two centuries, first in Europe and then in the USA, Japan and the USSR, small but often influential groups have embodied the very form of transverse operations more or less alluded to by the Triple Helix and New Production of Knowledge. 28 This frequently informal and unofficial group of practitioners, dubbed ‘research-technologists’, has historically generated generic devices (artefacts and methodologies). Such devices (for example the
ultracentrifuge, rumbatron, Fourier-transform spectroscopy, stereo-comparator, laser, and so on) take the form of open-ended instrumentation that spread across the boundaries of science and engineering, academia and industry, metrology and state service, as specialists in particular niches adapt and integrate them. Research-technologists and research-technology operates at the interface between established organizations and institutions. They stand ‘in-between’ orthodox professions and bodies, and are thereby interstitial.29 They both sustain instituted differentiations and divisions of labour and violate them. Research-technology, an ordinary albeit often un-noticed feature of near history and contemporary life, is in some key respects emblematic of what the Triple Helix and New Production of Knowledge seek in their different ways to grasp. The challenge for both perspectives is to identify and probe similar transverse entities, to show how they function, and to indicate their potential in a social, economic, cognitive and technical order experiencing rapid change.

Social studies of science and technology are a privileged vantage point from which to analyze the changes that are re-configuring and fusing cognitive, artefactual and social factors. Since changes on such a grand scale prove elusive, there is a tendency to simplify, and to deal in headline-grabbing metaphors. Utmost care must be taken to ground concepts and conclusions in empirical studies, to establish the limiting conditions of their results, and to exercise prudence when articulating models so that they critically reflect the constraints of data. Such guidelines should be kept in mind in the New Production of Knowledge and Triple Helix perspectives, to ensure that they contribute something enduring to scholarship and practice. The sad alternative is that they simply nourish an unproductive frenzy, and be little more than fleeting fads.

Notes

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1. For an analysis of the critical paths along which science and technology led society since 1945, see Jean- Jacques Salomon, Survivre à la science: Une certaine idée du futur (Paris: Albin Michel, 1999).


5. Neither does the ‘Special Issue: Triple Helix’, Research Policy, Vol. XXIX, No. 2 (February 2000), function as a doctrinal statement in the same way as does Gibbons et al., op. cit. note 2.


10. A group headed by Joske Bunders at the Free University of Amsterdam is undertaking promising research in health care and biotechnology using hypotheses drawn from the New Production of Knowledge.


12. An important corrective to this generalization is in the research of Roland Waast of the Institut de Recherche sur le Développement, which sees in the New Production of Knowledge a fruitful approach to studying transformations in the organization and work of science and technology in post-1960s Africa.


15. This brief summary does not do justice to the details, intricacies and complications of the theory. My present level of understanding does not allow me to move beyond these general precepts, and I suggest that this may be symptomatic of a broader problem and even malaise.

16. For example, comments and objections about the unintelligible language used in framing the theoretical components of the Triple Helix were rife during a meeting organized by Terry Shinn and Benoît Godin at the Paris Maison des Sciences de l’Homme in June 1998, which compared the Triple Helix and New Production of Knowledge perspectives. Similar complaints were voiced at the Rio de Janeiro meeting devoted to the Triple Helix in April 2000.


18. Ibid., 47–49.

19. Ibid., 110.

20. Ibid., 226.

21. Ibid., 167.


27. This paragraph does not appear in the French version of this paper.


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