

one | Science and citizenship

1 | Introduction: science, citizenship and globalization

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The need to clarify our understanding of the complex interfaces and intersections between science and citizenship is now more pertinent than ever. There have always been issues and controversies over how people relate to science, and how science reflects its human contexts; but these are now unfolding in a new, more pervasive and complex, and arguably more urgent, context. Globalization is changing the nature of science and technology, as it is being shaped by their developments: altering the intensity of innovation of new technologies, and the resulting constitutions and flows of knowledge and expertise, and the character and scope of risks and uncertainties. Globalization is also implicated in the changing nature and contexts of citizenship: internationalizing governance and the networks through which people might press claims, and forging new solidarities and forms of connection between once more disparate local groups. Moreover, as recent analyses of the molecularization of the life sciences have suggested (Rose 2001), politics and citizenship are themselves ever more intimately connected with the subtle shaping of human subjectivities that form the cultural undergrowth and underpinnings of the forms of politics of late-modern, globalized times.

With these changes, there is now an expanding array of overt engagements between science and citizens. Along with the recognition of the ways in which scientific discourses and notions of human agency and citizenship have for long been tacitly intertwined and mutual, these proliferating encounters force us to break down established analytical categories to recognize new synergies between expert and lay knowledges, new linkages between local and global processes, new relationships between state and non-governmental action, new networks of international activism, and a variety of hybrid forms of public and private control and ownership that frequently transcend national boundaries. Equally, many of the categories that might once have been used to think about these engagements in different parts of the world – North and South, developed and developing countries, indigenous and modern – no longer seem salient.

This changing context suggests a convergence between two loosely

defined bodies of work which have, to date, remained rather separate. On the one hand, the field of science and technology studies has since the 1970s examined issues of scientific and technological practice and culture, as well as the specific technological products and risks of modern science, in 'Northern', largely industrial settings. On the other hand, development studies, especially their anthropological contributions, have engaged with similar issues in 'Southern' settings, but with perhaps a greater emphasis on agricultural and rural issues, on the connections between technology and livelihoods, and on the perspectives emerging from so-called 'indigenous' knowledges in relation to modern expert-knowledge interventions. Emerging separately, as they have, each of these fields of work has developed distinct theoretical and analytical traditions, and thus ways of conceiving of the relations between science and citizens. The necessary convergence between these bodies of work in an era of globalization invites a bringing together of these streams of analysis to explore ways in which they might mutually enrich, build on and critique each other. Science studies (the Sociology of Scientific Knowledge – SSK) have for over a decade addressed, and tried to encourage policy actors to recognize, the cultural dimensions of the interactions of 'lay' public knowledge with scientific knowledge over risk and environmental issues, health programmes and the like. The striking correspondences between this and anthropology's long-standing interest in the encounters between modern and indigenous knowledges have only recently been pursued. Moreover, the theoretical realization of these 'cognitive' interactions as much more than this, as encounters between different practical-cultural ways of being as well as ways of knowing – ontologies – has occurred in both disciplinary domains, but its implications have not been jointly addressed. 'Post-colonial science studies', for example (see, e.g., Anderson 2002; Verran 2002), have recently combined SSK and anthropological perspectives on encounters between indigenous cultures and modern environmental science and practice in ways that open up important new issues for modern scientific culture and its self-understandings. This bears upon wider processes of globalization.

This book has emerged from such ongoing conversations between scholars of science and technology studies, especially the more specialist field of SSK, and development studies, conducted through a series of meetings and exchanges over the last few years. By bringing together a group of authors who perhaps would not normally appear together in a single volume, we aim to explore the correspondences, convergences, potentials and – in some cases – divergences between their central intellectual issues and ways of approaching them. Perhaps because all the contributors to this book are engaged in some way in critiquing mainstream approaches

to the study and practice of development and science and technology, many commonalities emerged, although often refracted through different terminologies, different empirical concerns and different types of policy engagement. Considering these commonalities, differences and potential new avenues, the book casts new light on the ways we understand the institutions and governance of science in a globalizing world: the ways we understand questions seen as ones of risk and uncertainty; the ways we understand citizenship and public engagement with science; and the ways we understand issues of knowledge, practice, agency and expertise.

In turn, there arises a set of challenges for prevailing attempts to orchestrate deliberative and participatory processes around issues of science and technology. Thus, although it has been recognized sporadically over the years, the emerging correspondence between the concerns and perspectives of science and technology studies about the 'democratization of science' in developed societies on the one hand, and the focus of development studies on citizen participation in expert-led development programmes and policies on the other, remains to be developed and exploited. By far the most dominant way of describing the confrontations and issues between modern discourses and interventions and 'indigenous' actors has been as if these were purely cognitive processes. A liberal enlightened perspective has thus been to talk of overdue recognition of the saliency and validity of hitherto marginalized and disparaged forms of knowledge, often local in distribution and practical in focus. More recently, however, both anthropological and SSK insight have come to understand knowledge as cultural practice that sustains and is sustained by these cognitive idioms, but which crucially stretches beyond them alone. This has led scholars such as Latour and Stengers to advocate an understanding of the countless typical – and almost definitive of our times – conflicts between scientific and 'lay' knowledges as not just epistemic conflicts between ways of knowing, but as reflections of different ways of being, of practising and relating – of ontologies. Moreover, the 'reflexive turn' in social science and humanities cultivated the insight that what we see as representational knowledge is not simply that, but is also subtly performative, in that it inevitably reflects and tacitly projects models of the human subject into the public world. This is true of representations of nature as well as of social worlds.

Thus, whereas dominant understandings of the chronic latter-day crisis of public (lack of) legitimacy or mistrust of science see these as cognitive defaults, either on the part of the publics of science or modern rationality (the 'deficit model'), or on the part of science when it neglects valid non-scientific knowledge (Collins and Evans 2002), others see them as unrecognized ontological conflicts between incompatible ways of life. Thus, these

problems, whether in developed, developing-world or global settings, are a cultural challenge to dominant modernity and its hegemonist scientific culture. This implies a demand for self-reflexive humility, awareness and debate. This could be described as the main point of this book – to argue that this self-problematization and reflexivity of scientific institutions, and this recognizing of alterity in a respectful way in the face of proliferating local and global public alienation, is an essential move. It is of course an issue of scientific knowledge's mutual construction with global and local forms of power; but clarification here is key to generating the possible conditions of sustainable cultural, as well as technical, robustness through exploring different visions of globalization.

This book is divided into four sections. Following this brief introduction is an overview chapter that traces the varied contributions of science and technology studies and development studies to understanding science and public engagements with it. It examines the connections between strands of debate in these fields, and different theories of citizenship; connections that have rarely been made explicit before, but which help us move towards fruitful ways of understanding citizenship practice in today's globalizing world. Part Two offers a series of perspectives on science and citizenship from different standpoints. Part Three picks up the emergent themes in a series of case studies, covering issues ranging from medical genetics, agricultural biotechnology, occupational health and HIV/AIDS to transport technology and food security, in settings including rural Sierra Leone, urban Britain, China, South Africa, India and Brazil, as well as in international scientific, policy and activist networks. Part Four engages critically with the move to participation and democratization of science in both North and South, and illustrates some of the dilemmas involved through a series of short examples where citizens have been invited to deliberate on 'science and technology issues'. To convey the sense of conversation and ongoing debate between these fields of work, Parts Two to Four are preceded by a short editorial commentary, which both highlights some of the key issues raised by the chapters in each section and points to unresolved issues, further questions and new avenues of inquiry.

In the remainder of this introduction, we first highlight a series of emergent themes linking science, knowledge and governance which resonate in the book. In different ways, as we go on to show, these each suggest challenges for the ways in which we understand the relationships between citizenship and knowledge in a changing global context. A key issue raised in this intellectual context is also the relationship between the subtle dynamics of the formation of human subjectivities through 'representational' knowledges, and our ideas of citizenship in public contexts.

Challenging modernist development A recurrent theme in the book is the recognition of the unacknowledged cultural contingencies of scientific knowledge as deployed in the framing, definition and attempted resolution of public policy issues. Depending on the setting and the institutions involved, these may be defined in terms of risk and regulation, or more broadly in terms of trajectories of modernist, technology-led development. By making explicit these cultural, institutional and power-laden processes underpinning science and technology agendas, and the forms of subjectivity and citizenship which they normatively embody, the book challenges any assumption that science is independent of society and politics, or that these ways of thinking about public policy issues are universal or inevitable. Indeed, the book brings to light a variety of ways in which modernist development and its policy trappings are challenged, both discursively and practically, along with the meanings of issues involving new technologies. In some settings, these challenges take the form of 'alternative development' or anti-globalization, or counter-hegemonist globalization movements of the kind highlighted by Escobar (1995), Sachs (1992) and others. Others emphasize a form of reflexive modernization and sub-politics as part of an emergent global 'risk society' (Beck 1992, 1995, 1998).

Increasingly, science and technology agendas and networks are being pursued on a global scale, whether through international public policy and agreements, or trade and commerce. Particular views of science, technology and policy are embedded in these new global networks. North-world authored globalization and commodification cultures are developing new kinds of global knowledge-culture and epistemic politics, as reflected, for example, in the proliferating attempts to enrol indigenous people in global scientific and commercial systems of research, with intellectual property rights to exploit these indigenous knowledges for profit. Yet as the book shows, science and technology issues are subject to a variety of alternative and sometimes incompatible meanings. Those that emerge from specific, localized cultural contexts have, in some circumstances, been linked and mobilized in new global networks – a case in point being the mobilization of 'indigeneness' and its knowledges themselves as part of the anti-globalization movement, and the objectification and standardization of such knowledges in global databases in order to 'protect' them as a global cultural resource.

Reframing dominant expertise Thus, science has been recognized as needing to accept its own cultural boundaries, frames and blinkers that obscure and patronize the intellectual and moral substance of other ways

of knowing. Whether in 'Southern' development contexts (e.g., Leach and Mearns 1996; Scoones and Thompson 1994) or 'Northern' settings (e.g., Irwin and Wynne 1996), work has challenged the dominant assumptions of scientific and other powerful institutions, and extensively documented the independent intellectual capacities and substantively grounded epistemic cultures of multifarious lay publics. Thus, the institutions of scientific knowledge have been invited – whether or not they have responded is a different matter – to recognize other kinds of knowledge framed within other practical cultural assumptions, meanings and life-worlds. Publics, whether rural farmers in Africa or users of health services in the UK, have been acknowledged as having not just other bodies of knowledge, but also other ways of knowing – different systems of meaning, saliency and value – that need to be taken into account. This cultural understanding of the globally multifarious eruptions of the public mistrust of modern science places a fundamentally different perspective on the issue from those that inform most public policy and private corporate culture across the world.

It has increasingly been recognized, however, in both the sociology of scientific knowledge (e.g., Verran 2002) and anthropology (e.g., Strathern 1999) that this is a matter of incommensurable practical human-cultural ways of being (ontologies), not only of different human epistemologies or preferred ways of knowing. Major, internationally reverberating social conflicts, in which public unwillingness to defer to presumptive scientific authority has been interpreted as public unwillingness or inability to 'understand' scientific knowledge or method, have been recognized instead to be cultural confrontations between different, incompatible ontologies. The projections of modern policy and scientific institutions of the 'public' as typically vacuous in epistemic terms can be understood instead as the projections of insecure institutions unable to adopt more self-reflexive orientations towards their own social relations and cultural parochialism. Such lack of open self-reflexivity can, of course, be seen as a means of power. From this view, those conflicts between powerful institutions acting in the name of scientific rationality and publics have thus been recognized as less a reflection of public ignorance and irrationality and more a reflection of different frameworks of meaning within which salient observations and propositional beliefs are defined and given standing.

Indeed, there is now recognition that publics have salient knowledges and critical perspectives that should be taken seriously as substantive inputs into the planning, design and implementation of scientific interventions and development initiatives previously assumed to be the sovereign domain of expert scientific bodies. These interactions take place in particular, and now often globalized, institutional contexts, however,

where power relations shape the terms of engagement. For example, the global documentation, aggregation, archiving and databasing of 'indigenous knowledges' is seen by organizations such as the United Nations World Intellectual Property Organization (WIPO) and the United Nations Educational Scientific and Cultural Organization (UNESCO) as a means of protecting them from exploitation and perhaps extinction, and of recognizing rights to ownership of products that may lead to economic and other returns. But the translation into formal quasi-scientific terms itself poses dilemmas, representing knowledges in abstracted terms stripped from the contexts in which they have practical enactment, human identity and cultural reality. Indigenous knowledges are thus rendered formally commensurate with other abstracted and translated (scientific) knowledges that have been given a new, standardized 'global' (a)cultural collective potential being. Thus, by removing knowledge from context, the power of dominant framings and the potentials for commercial exploitation that they support are upheld. The implications for the 'subjects' or 'citizens' of such knowledge are problematic.

In both developing and developed society contexts, therefore, it has been accepted, at least in principle, that science can gain democratic public legitimacy only if it recognizes its own need to understand itself in relation to these other cultures, and to learn respectfully to negotiate with and accommodate to them, rather than dismiss them as vacuous, untrustworthy and emotive. Perhaps in reflection of their institutional power and privileged presumed influence in such issues, however, scientific institutions have proved to be very resistant to opening themselves up to such self-reflexive needs and opportunities. A number of chapters in the book explore and reflect on both the problems that such lack of open self-reflexive capacity engenders and the possibilities for increased institutional responsiveness and openness.

Meanings and practices of risk and uncertainty Directly connected with the preceding observations, another recurring theme in the book is how risk is understood and problematized. Much debate about the relationships between science and publics has been cast in terms of a narrow, technical definition of risk, one amenable to prediction, management and control by expert institutions and public policy. In this framing of the issues and debate, publics are assumed to be aware of (or to misunderstand) risks in these same technical terms, and thus a key challenge for policy is seen as that of educating publics and communicating risks in rational terms. As several chapters argue, however, issues whose meanings for publics may be more multi-dimensional and varied are presumptively framed as ones of

risk, as if this were an objective and universal public meaning. Furthermore, scientific and policy institutions often frame as 'risk' – implying calculable probabilities of known outcomes – what is actually uncertainty or even ignorance about the possible consequences of a given form of technological development, and ambiguity as to the proper meanings of the issue(s) at stake. These more challenging dimensions are thus concealed from formal public treatment and negotiation.

This institutional culture of denial of unpredictability and (thus) of lack of control combines with the expert denial of any epistemic capacity of lay public culture, and with the assumption imposed on the public that the meaning of the issue in hand is indeed one of propositional truth amenable to science – is this safe or not? In different substantive forms, this basic set of processes appears to encompass both developed and developing-world situations. Yet publics may have different meanings defining the issue, which may include their own problematization of the institutional culture of science and its presumptive imposition of scientific meanings without recognizing public definitions of the issue. As several chapters show, this is so far from scientific institutional imagination that public dissent is taken only to confirm the starting assumption that the issue is indeed a scientific one like risk, and thus dissent is confirmation of public incapacity to understand that science. These self-defeating cultural reflexes of institutional science contribute to science's own public legitimacy problems, which are then blamed on someone else. As well as embodying tacit normative projections of the proper citizen, they contribute to the oblique forms of negotiation and shaping of public agency in such issues.

Debates framed in terms of risk also focus on the consequences of science and technology development. Thus, questions about the setting of science and technology agendas in the first place, about processes of innovation, and about whose priorities or visions of development or the good society these are to address, are left begging. The assumption is that public concerns are focused on risks and consequences rather than on the unstated and unaccountable human purposes, aspirations, priorities, expectations and aims that drive innovation-oriented scientific knowledge. This latter, hugely important domain of science – partly, of course, because innovation-oriented knowledge is usually controlled by the private sector rather than the public sector – has been simply excused *de facto* from any of the questions of public accountability, public involvement and participation that have swept those scientific fields associated with risks and consequences.

Risk discourse appears to have been less dominant in development contexts, at least to date. Some research efforts have concentrated more

on diverse forms of technology innovation, farmer creativity and local knowledges that respond to particular social and livelihood priorities (e.g., Richards 1985). Both expanding on and drawing lessons from this work for other settings, several chapters in the book make the case for increased attention to public engagement in 'front-end' innovation questions. They also argue for a broader recasting of science and technology debates around notions of justice, rights, livelihoods and the aims and purposes of development, scientific innovation and societal change.

Participation, democracy and accountability Each of these emergent themes raises challenges for processes of deliberation and participation. There is a long tradition of participation in development planning and programmes, which has more recently been joined by a tide of new procedures such as consensus conferences, citizens' juries and deliberative panels, which are now being applied to science and technology issues in both North and South. It has become evident, however, that the tacit prior framing of the modes and scope of such participatory initiatives, through the imposition on these of particular framings of the science in question and of presumptive normative models of 'the citizen', can lead these proclaimed 'openings' to more democratic forms to have a disciplining and thus participation-closing role.

The features of this paradoxical 'new tyranny' of participation (Cooke and Kothari 2001), especially in relation to scientific knowledge and the sometimes uncritical enthusiasm for deliberative techniques, are analysed in this book in these terms, with a view to assisting a more realistic and reflexively aware integration of such mechanisms into more broadly based and robust approaches.

Experiments with participation and deliberation over science, as the cases in Part Four exemplify, have largely been locale-specific. Yet increasingly, science and technology issues, and public engagement with them, unfold over much larger, and globalized, political fields of technology politics and human ethics. This requires a move beyond a preoccupation with techniques and procedures to embrace a more fundamental political analysis of science and technology, encompassing issues of agency, power, accountability and democracy. As Sheila Jasanoff suggests (in her chapter), this would pose such questions as: Who is making the choices that govern people's lives? On whose behalf? In which forums and with which discourses? With what rights of representation? According to whose definitions of 'the good'?

A further issue raised in recent debates (Fairhead and Leach 2003; Hinchcliffe et al. forthcoming; Latour 2000, 2004; Stengers 1996; Whatmore

2002) has been the role of nature and technology as agents in democratic processes. This has been highlighted in response to the critique of relativist-humanist accounts of scientific knowledge as constituted only by dominant 'social interests'. In SSK, the coproduction or mutual construction thesis (Jasanoff 2004; Jasanoff and Wynne 1998; Latour 1987) has long recognized how objective materiality plays a shaping role in representative knowledge of nature, without mistakenly giving it sole agency. But exploration of the idea that material non-human realities play quasi-subject roles in public arenas has become an influential project, as in Latour's idea of the 'parliament of things'. This raises important questions about whether, and to what extent, notions of citizenship should be extended to encompass non-human objects. It also alerts us to attend to the implicit models or assumptions of natural objectivity and human subjectivity embedded in scientific knowledge-citizen encounters in today's globalizing world.

Performing citizenships

Therefore, these emergent themes concerning challenges to dominant notions of modernist development, representation (intellectual and political), objects and subjects, scientific expertise and risk, as well as the call for a broader, more politicized democratization of science, have important implications for how one understands citizenship. As we explore in the next chapter, mainstream approaches to 'citizen involvement' with science and technology have been based on implicit models of the citizen grounded in versions of liberal theory. In these, citizens are either expected to engage passively with expert scientific institutions, especially those linked to the state, or to participate in forums orchestrated by such institutions. This contrasts with a model of the citizen as a more autonomous creator and bearer of knowledges located in particular practices, subjectivities and identities, who engages in more active ways with the politicized institutions of science. Such citizens do not act solely as individuals, as in liberal theory, but through emergent, and sometimes global, social solidarities that may unite people around particular issues and visions, whether these be fluid and shifting with circumstances, or more lasting.

A range of normative terms that have entered the lexicon, many of which appear in the following chapters, such as 'practical reason' (Fischer *infra*), dialogue and a 'listening science', 'cognitive justice' (Visvanathan *infra*), and an 'epistemology of the South', reflect these more performative and embedded ideas of scientific citizenship. Although sometimes implicitly, these developments reflect a recognition that knowledge, including scientific knowledge and especially scientific knowledge as deployed in public arenas, is inalienably cultural in that it embodies, reflects and projects

commitments of a human kind, which also shape human relations and identities, imagined communities and ontologies. These explicit representational forms also, in a performative manner, tacitly project into the public domain normative models of the human that become part of the cultural repertoire and thus have influence over real emergent human behaviour, human relations and human imagination. This performative cultural dimension of scientific knowledge is what Verran (2002) has called the tacit provisional performance of human ontologies in the making. In short, scientific engagement makes citizens, but in more complex ways than often acknowledged.

Such tacit, oblique and emergent performance, as well as the more overt performance of citizenship in relation to science – and difficulties for scientific institutions in accommodating this – are now being played out in many different settings and around many different issues across the world. Thus, for example, the UK public controversy over genetically modified (GM) crops and foods has been insistently defined by scientific and policy institutions as an issue of risk, with a more recent elaboration to include what are accepted as legitimate public ethical concerns about ‘tampering with nature’ or ‘playing God’. These ethical concerns have been dealt with, however, by framing them as individual emotive concerns, which are deemed a private matter on which people should decide for themselves, and act by individual choice in the marketplace. There is absolutely no acknowledged public dimension to this ethical concern arising from scientific-institutional culture itself. Thus, public responsibilities are seen to lie in identifying and managing the risks, and public opposition is identified with anti-science or misunderstanding of science. This default role for science – risk science – sequesters human political and cultural responsibilities, issues and agency as if these were discoverable, resolvable and replaceable by science. It is precisely the political, ethical and cultural dimensions of GM technology, however, and what it implies for broader societal futures, which have become the focus for citizen action and mobilization around the world. Public concerns and autonomous, active citizenship are also responding to the perceived inadequacy and untrustworthiness of scientific institutional culture. This could be of much wider relevance to the issues engaged in this collection.

Chapters in this book examine a range of cases where citizens are engaging with science, with a range of responses from expert institutions and a range of effects on the governance of science and technology. Overall, the book argues that such multivalent performative dimensions of citizenship should be recognized for what they are, while the hidden framings and implicit practices and meanings of scientific institutions should be

Science and citizenship | 1

rendered explicit and accountable to democratic debate and negotiation with those whose subjectivity they represent and shape. In the context of globalization, this book, drawing on the confluence of development studies and science and technology studies, sets out an agenda for analysis and action in terms of confronting and rendering more sustainable and legitimate scientific and technical cultures, creating new forms of knowledge network, and through the corresponding forms of human solidarity, enhancing democratic global citizenship.