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44 Anthropology of Science and Technology

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The anthropology of science and technology is an expanding arena of inquiry and intervention that critically examines the cultural boundary that sets science and technology off from the lives and experiences of people. Most research in this arena draws on ethnographic fieldwork to make visible the significance and force of this boundary, as well as meanings and experiences that cut across it or otherwise get hidden. Key categories of projects include juxtaposing shared systems of cultural meaning, following flows of metaphors back and forth across the boundary, and retheorizing or relocating the boundary itself in ways that reconnect science and technology to people. While advancing understanding of how people position science and technology in both specialized and everyday worlds, the anthropology of science and technology also calls attention to cultural possibilities whose realization might help expand participation in decision making about science and technology.

Helping STS Fulfill Its Dual Objectives

The unique contribution of this field to science and technology studies (STS) is that it helps revive and refocus questions regarding relations among science, technology, and people. STS research and researchers are held together by their diverse, yet collective, efforts to trouble and transform the dominant, but simplistic, model or image of science and technology in society. According to the dominant model, researchers live in specialized technical communities whose deliberations are essentially opaque and presumably free of cultural content. Knowledge, in the singular, is created by these bright, well-trained people located inside the academy and then diffuses outside into the public arena through mechanisms of education, popularization, policy, and the benefits of new technologies. Its social significance is evaluated exclusively in the public arena, where knowledge is used, abused, or ignored. The outward travel of knowledge preserves the autonomy of creation and establishes a sharp boundary between science and technology on the one side and people on the other, including the actual lives of scientists and technologists.

STS has sought to engage this model in two ways. First, it brings together researchers who analyze the conceptual and the social dimensions of science and technology simultaneously and in historical perspective. Second, by offering new ways of thinking, STS promises to afford society new pathways for confronting and resolving problems that involve science and technology. STS thus offers the dual trajectories of theory and intervention, of proposing new frameworks of interpretation

and participating critically in societal problem solving. These activities complement one another. Good theory defines pathways that make a difference, and successful acts of critical participation depend upon novel theoretical insights.

During the 1980s and early 1990s, a major focus within STS was on a philosophical debate between 'objectivism' and '(social) constructivism.' Constructivism provided a major theoretical advance over 1970s research on the 'public understanding of science' and the 'impacts' of science and technology, which tended to take for granted the internal contents of science and technology (see *Public Understanding of Science; Technology Assessment*). One important body of constructivist work was often labeled 'anthropology of science' because it relied on the direct observation of scientists in laboratories to link scientific practices to knowledge development. For more information on this formative strand in the anthropology of science, see *Laboratory Studies* and *Actor Network Theory*. By questioning how science and technology gain internal contents, the philosophical debate between objectivism and constructivism concentrated attention on the science/technology side of the cultural boundary with people. Also, a focus on the emergence and stabilization of either new scientific knowledge or new technological artifacts tended to maintain the more general cultural separation between science and technology (see *Social Construction of Science; Social Construction of Technology*).

The newer strands in the anthropology of science and technology explicitly foreground the interventionist potential of STS by moving back and forth across the boundary between science/technology and people, investigating its force and making visible meanings and experiences that get hidden when it is taken for granted. In this work, the commitment to ethnographic practices forces attention to alternative pathways for critical participation as an integral part of theoretical innovation (see also *Ethnography*).

Helping Anthropology Rethink Culture

As recently as 1988, the American Anthropological Association rejected proposed panels on the anthropology of science and technology on the grounds such work did not fit under the AAA umbrella. Things had changed by 1992 as a series of panels on 'cyborg anthropology' and on the work of Donna Haraway attracted standing-room-only audiences in a ballroom setting.

Key to this shift was a growing recognition that anthropological debates over the status of cultural analysis and cultural critique were similar to developments and deliberations in STS. Anthropologists grew hopeful that analyzing and critiquing the dominant model of science and technology in cultural terms might further people's understanding of how sciences and technologies, including anthropology, live in society. Emerging questions included: What are the implications of accounting for science, technology, and people in cultural terms? Might the finding of wider cultural meanings in science and technology improve searches for alternative configurations? To what extent has anthropology itself depended on the dominant model of science and technology in society? How can one participate critically in science and technology through ethnographic work?

As it emerged from symbolic anthropology during the 1970s, the concept of culture drew from the predominant model of language as an underlying grammar, structure, or system of symbols and meanings (see *Culture, Contemporary Views*). Beneath surface differences in speech and action among competent participants in a given community lies a more fundamental sharedness, a bounded

'culture.' This concept of cultures as sets of shared assumptions or presuppositions depends upon a contrast with the concept of 'nature.' Where nature provides people with base needs and desires, culture provides content and meaning.

Until the 1980s, it appeared difficult to apply the concept of culture to science and technology. While theorizing culture as a bounded system helped in accounting for differences across cultures, this approach offered no means of accounting for differences within cultures. Yet research questions in STS typically focused on the latter. Also, much research in anthropology itself, e.g., kinship theory, depended upon the nature/culture distinction for its legitimacy. Treating anthropological work itself as a cultural enterprise could have threatened to undermine the discipline.

As Franklin (1995) put it, by the 1990s "several trajectories coalesce[d] to produce . . . momentum" for an emerging anthropology of science and technology. Feminist anthropology had made visible the role of biological assumptions in gender and kinship studies (see *Kinship in Anthropology*). Poststructuralism made it possible to think about power-knowledge relationships and to make the conceptual limitations of the 'human' a focal point for social theory (see *Knowledge, Sociology of; Postmodernism in Sociology*). Postmodernist critiques of science and technology called attention to the processes of their production, making 'progress' a contingent effect (see *Cultural Studies of Science*). In revealing how anthropologists 'write culture' by turning people into 'others,' postmodernism in anthropology introduced 'cultural critique' as an anthropological practice (see *Cultural Critique, Anthropological*). Cross-cultural comparisons of knowledge systems began to reposition Western science as ethnoscience (see *Anthropology of Knowledge; Indigenous Knowledge, Science Studies and; Postcolonialism*). The rise of interdisciplinary cultural studies juxtaposed 'popular' with 'high' cultural forms, revealing power relations between the two and re-theorizing culture as a site of active work (see *Cultural Studies of Science*). Feminist critiques of science demonstrated its saturation with gender metaphors, and feminist critiques of reproductive technologies provided compelling accounts of women's experiences that could not be counted unproblematically as the benefits of innovation (see *Feminist Epistemology; Gender and Technology*). Cross-disciplinary interests in emerging transnational forms demanded simultaneous attention to technology, knowledge, and capital (see *Globalization, Anthropology of; Postcolonialism; Capitalism, Global*). Growing demands for accountability across the academy in general fueled interest in how ethnographic research can make a difference in the arena under study (see *Ethnography; Advocacy in Anthropology*).

During the early 1990s, cultural anthropologists studying science and technology actively resisted the label 'anthropology of science and technology' on the grounds it masked these trajectories, confining diverse work to a bounded subdiscipline. The label works only to mark a collection of intellectual activities within which competition exists not to achieve domination but to make a difference and where border crossing is accepted to enhance the life chances of what the dominant model submerges. Ongoing projects fall into roughly three categories, with individual researchers and studies often contributing to more than one.

Juxtaposing Cultural Systems of Meaning

The publication of Sharon Traweek's *Beamtimes and Lifetimes* in 1988 marked the emergence of projects that identify and juxtapose cultural systems of meaning in science and technology. Rather than focusing solely on theory change in science, Traweek provides "an account of how high energy

physicists see their own world; how they have forged a research community for themselves, how they turn novices into physicists, and how their community works to produce knowledge” (p.1). Studying the culture of high energy physicists extends and transforms the anthropological project of cross-cultural comparison by studying people who live in more than one culture at the same time, in this case those of the international physics community, Japan, and the United States.

Demonstrating sharedness among high-energy physicists and then setting physicists off as a community achieves two key contributions. It repositions the dominant model of science and technology, which physicists both embrace and embody, into one among many possible cultural perspectives without suggesting that all perspectives on physical knowledge are equal. The ethnographic approach also locates the researcher within the power relations that constitute the field of study and makes visible ways in which scientists function as people who live social lives.

The juxtaposition of shared systems of meaning has proven fruitful in analyzing public controversies over science and technology. Articulating subordinate perspectives and locating these alongside dominant ones demonstrates that factual claims gain meaning in terms of more general frameworks of interpretation. Such work also intervenes in power relations in ways that highlight mediation and collaboration as possible pathways for resolution (see also *Scientific Controversies*).

Representative contributions in this category juxtapose Brazilian spiritists, parapsychologists, and proponents of bacterial theories of cancer with 'orthodox' perspectives (David Hess); anti-nuclear weapons groups with nuclear weapons scientists (Hugh Gusterson); creation science with evolutionary science (Christopher Toumey); anti-nuclear power with pro-nuclear power groups (Gary Downey); artificial intelligence researchers with expert system users (Diana Forsythe); advocates of mid-wifery with obstetrics (Robbie Davis-Floyd); Marfan scientists with technicians and activists (Deborah Heath); a unified Europe with separate nation states seeking space travel (Stacia Zabusky); nuclear power plant operators with plant designers (Constance Perin); and competing workgroups in industry (Frank Dubinskas). Recent work questions the culture/people relationship by understanding cultures as, for example, shifting discourses (Gusterson) or recursive, cross-cutting perspectives in a social arena (Hess). Future work will likely review the notion of sharedness, no longer asserting it as a condition of anthropological analysis but exploring what gets accomplished when it can be demonstrated empirically.

Following Flows of Metaphors across the Boundary

The publication of Emily Martin's *The Woman in the Body* in 1987 marked the emergence of projects that follow flows of metaphors from general cultural life into science and technology and back again into people's lives and experiences. Writing a cultural history of the present, Martin demonstrates how medical conceptions of menstruation and menopause draw upon metaphors of production in portraying these as breakdown, the failure to produce. In addition to contrasting descriptions from medical textbooks with an ethnographic account of the actual experiences of women, Martin also experiments with reimagining menstruation and menopause as positive processes of production.

Following flows of metaphors brings a new approach to the study of public understanding and of what the dominant model of science and technology characterizes as impacts. It calls direct attention to the existence and life of the cultural boundary that separates science and technology from people. How do people import scientific facts and technological artifacts into their lives and worlds? How

does the dominant model of science and technology live alongside and inform other cultural meanings?

Like the strategy of juxtaposition, following metaphors focuses attention on how people involve themselves with science and technology, making visible those meanings and experiences that do not have a place within the dominant model, alongside those that do. What sorts of effects do scientific facts have in people's bodies and lives? How do experiences with technologies go beyond the simply positive, negative, or neutral? How do emerging sciences and technologies contribute to the fashioning of selves? Such work makes visible patterns and forms of difference that may not correlate with demographic categories of race, gender, and class.

Finally, following metaphors introduces the possibility of speculating on alternative cultural possibilities, including narrative experiments with counterfactual scenarios. While sharing with readers an anthropological method of critical thinking, such speculation also forces more explicit attention to how anthropological accounts participate critically within their fields of study. How, for example, might choices of theory and method combine with aspects of researchers' identities to shape pathways of intervention?

Work along these lines follows how sonography and amniocentesis accelerate the introduction of medical expertise into pregnancies (Rayna Rapp); the cultural origins of Western science and its shifts over time (David Hess); how people calculate in diverse settings (Jean Lave); the cultural meanings of medicine in everyday life (Margaret Lock); the narrative construction of scientists' autobiographies (Michael Fischer); creative adjustments when medical expertise fails to account for pregnancy loss (Linda Layne); the flows of meanings that constituted the reproductive sciences as sciences (Adele Clarke); what living with gender assumptions means for women scientists (Margaret Eisenhart); how Bhopal lives as fact and image in different enunciatory communities (Kim Fortun); and how patents travel around the world (Marianne De Laet).

Future work is likely to elaborate questions of scale and identity. How do metaphors gain effects at different scales and how do meanings that live at different scales combine in people's lives and selves? How do people respond to meanings that summon and challenge them, positioning themselves in searches for identities that work (see also *Identity, in Anthropology*).

Re-theorizing the Boundary between Science/Technology and People

The publication of Donna Haraway's *Simians, Cyborgs, and Women* in 1991 marked the emergence of projects that retheorize the boundary itself. Moving through the project of following flows of metaphors to reimagine categories that "implode" on one another, Haraway calls for "pleasure in the confusion of boundaries and . . . responsibility in their construction" (p. 150). Claiming the cyborg (see *Cyborg*) as a feminist icon and key marker of what she calls the "New World Order," Haraway forges attention to the contemporary dissolution of boundaries between human and animal, human and machine, and physical and non-physical. Challenging the 'god-trick' of universalism, she poses 'situated knowledges' (see *Situated Knowledge*) as a means of holding simultaneously to a radical historical contingency and a no-nonsense commitment to faithful accounts of a 'real' world.

This project calls attention to burgeoning collections of activities involving science and technology that live across the purported separation between them or across their boundary with

people. It includes the exploration of emerging fields that do not fit conventional disciplinary categories, such as biotechnology, biomedicine, and bioengineering, and documents the decline and loss of a distinction between basic and applied science. Following novel activities in research and production motivates the invention of new labels for the anthropological object of study, including, for example, ‘technoscience’ and ‘technoculture.’

The project of retheorizing the boundary between science/technology and people highlights the presence of the nature/culture distinction in anthropology of science and technology as well as in other areas of STS inquiry and intervention. Pressing questions include: Through what sorts of processes do analytic findings and interpretations become naturalized as facts in everyday, or popular, modes of theorizing? In what ways might analytic accounts, including claims about culture, depend upon facts from popular theorizing? How might new modes of theorizing about analysis contribute to rethinking the nature/culture distinction itself?

Finally, by calling attention to the difficulty of living within existing categories while attempting to theorize and embody new ones, retheorizing the boundary sharpens the question of intervention. Locating experiences that live across categories invites researchers to examine how emergent categories impact and inflect old ones. Through what sorts of pathways might reformulations actually intervene and achieve change in specific cases? How might it be possible to assess the extent to which reformulations and refigurations prove, in fact, to be helpful, and to whom?

Contributions to this diverse project explore how ideas of the natural help constitute cultural ways of knowing (Marilyn Strathern); the situatedness of practices in machine design and machine use (Lucy Suchman); opportunities for a ‘cyborg anthropology’ that studies people without starting with the ‘human’ (Gary Downey, Joseph Dumit, Sarah Williams); how reproductive technologies blur the facts of life (Sarah Franklin); emerging refigurations to constitute and categorize artificial life (Stefan Helmreich); the activities of biotechnology scientists who move outside the academy to gain academic freedom (Paul Rabinow); the importance of ‘good hands’ and ‘mindful bodies’ in laboratory work (Deborah Heath); how practices of tissue engineering materilize new life forms (Linda Hogle); experiences with PET scanning that escape the nature/culture distinction (Joseph Dumit); the contemporary production of ‘cyborg babies’ (Robbie Davis-Floyd and Joseph Dumit); experiences of computer engineers that belie the separation of human and machine (Gary Downey); possibilities for reinvigorating general anthropology by locating technology and humans in the unified frame of cyborg (David Hakken); and how African fractal geometry escapes classification in either cultural or natural terms alone (Ron Eglash). See also *Actor-Network Theory* for an approach that defines both humans and non-humans as ‘actants.’

Future work is likely to forge novel alliances among theoretical perspectives previously separated by the nature/culture distinction. Actively locating academic theorizing in the midst of popular theorizing will likely force modalities of intervention into focus. Finally, to the extent that the anthropology of science and technology succeeds in challenging and replacing the simplistic dominant model by blurring and refiguring the boundary between science/technology and people, wholly new projects of inquiry and intervention will have to emerge to take account of the changing context. See bibliography for additional reviews.

See also *Anthropology of Knowledge; Common Sense, Anthropology; Culture, Contemporary Views; Ethnography; Globalization, Anthropology of; Identity, in Anthropology; Ideology and Culture; Interpretation in Anthropology; Public Culture; Subaltern Theory; Subculture,*

Anthropology of; Symbolism, in Anthropology; Technology; Sociology of Science; Indigenous Knowledge, Science Studies and; Scientific Culture; Actor Network Theory; Gender and Technology; Cultural Studies of Science; New Forms of Science.

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