AHR *Conversation:*
Historical Perspectives on the
Circulation of Information

PARTICIPANTS:

PAUL N. EDWARDS, LISA GITELMAN, GABRIELLE HECHT,
ADRIAN JOHNS, BRIAN LARKIN, and NEIL SAFIER

In the last few years, the *AHR* has published four "Conversations," each on a subject of interest to a wide range of historians: "On Transnational History" (2006), "Religious Identities and Violence" (2007), "Environmental Historians and Environmental Crisis" (2008), and "Historians and the Study of Material Culture" (2009). For each the process has been the same: the Editor convenes a group of scholars with an interest in the topic, who, via e-mail over the course of several months, conduct a conversation, which is then lightly edited and footnoted, finally appearing in the December issue. The goal has been to provide readers with a wide-ranging consideration of an important topic at a high level of expertise, in which the participants are recruited across several fields and periods. It is the sort of publishing project that this journal is uniquely positioned to undertake.

In a sense, this year's topic, "Historical Perspectives on the Circulation of Information," pays homage to the very process that enables the *AHR* Conversation in the first place. After all, this project would have been inconceivable before the Internet and electronic mail made possible the kind of instantaneous communication that we now largely take for granted. One has to be rather young not to marvel at the ease of communicating and staying connected in this era of Facebook and the Web. Interestingly, however, one of the themes of the following discussion is the need to reject the kind of thinking that celebrates (or perhaps bemoans) technological developments in communication in terms of "rupture" or other such proclamations of new media "ages." Rather, the participants call our attention not so much to dramatic transformations as to the actual modes, techniques, and social interactions that have characterized communication in all times and places.

Joining the Editor in this conversation are Paul N. Edwards, who studies modern information infrastructures; Lisa Gitelman, a media historian interested in print culture and media, new and old; Gabrielle Hecht, who has worked on the nuclear industry in both France and Africa; Adrian Johns, a historian of science, of the book, and of intellectual property and piracy; Brian Larkin, an anthropologist
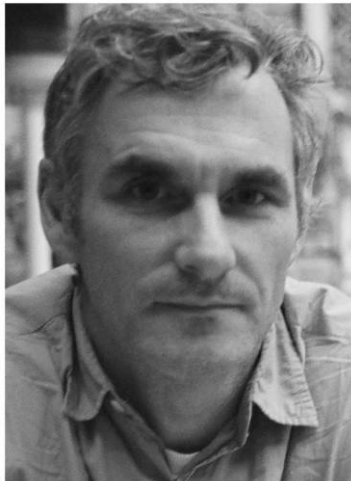
Paul N. Edwards

Lisa Gitelman

Gabrielle Hecht

Adrian Johns

Brian Larkin

Neil Safier

who has worked on forms of media especially in Africa; and Neil Safier, an early modern historian interested in the cross-cultural transmission of knowledge. In the discussion that follows, Edwards and Hecht, who often collaborate, will respond together at some times, separately at others.

AHR Editor: In most cases, the topics that historians think about and research are not those that impinge greatly on their own personal circumstances. This is implicit in the very nature of history—a remoteness in time, often too in space. And while an identification or sympathy with one's historical subjects is often part and parcel of the process of historical thinking, historical knowledge rarely results from direct experience. Wars, revolutions, slavery, peasant life, or the vicissitudes of statecraft— these are historical realities that few historians know firsthand. It is quite different with the subject of this conversation. Here, it is safe to assume, virtually everyone— certainly all academics—confronts daily new modes of the circulation of information. The Internet, especially the Web, is only the most conspicuous feature of what to many seem like the harbingers of an entirely new age. Indeed, it is the apparent novelty—the entirely unprecedented nature of how communication and information exchange have been transformed in a startlingly short period of time—that defines this phenomenon in many people's minds. One result of this perception is that the historical nature of these changes is obscured. Or if there is a historical understanding, it is often framed in terms of rather familiar narratives: the effacement of the old and its replacement with the (entirely) new; the increasing connectedness of people and places, definitively breaking down barriers of isolation and provincialism; the determinant effects of technology in reshaping people's lives; the ever-increasing velocity of change, creating sharper and more abrupt ruptures between generations; the information "overload" and its mixed effects; etc. Not to speak of the utopian and apocalyptic predictions that are extreme expressions of these narratives. As scholars deeply immersed in this subject, how can you help us understand it with greater awareness of its historical nature? What conceptual tools or analytical approaches might help us to complicate these narratives or disabuse us of their validity? How, in short, do we think historically about the phenomenon of information exchange and the circulation of knowledge?

Adrian Johns: The personal note on which this question begins strikes a chord with me. I've been a historian of the early modern book, among other things. Printing in around 1650 seems a subject categorically separate from the culture of information today: that is part of the sensibility of radical disjunction that the question invokes. Yet it seems to me now that my approach to that distant time owed a lot to the ways in which late modern information was being shaped in the mid-1980s, when I began graduate research. At that time I had relatively recent experience of being a coder, writing in FORTRAN and assembly language for a variety of tasks. The thing about that experience was that it made one jaundiced about the appearance of smoothness and self-sufficiency that even then was the aspirational norm for media systems (a category in which I'll include PCs and the Internet). One came to assume that beneath that veneer of slick universality *must* lie a whole series of ad hoc kluges: that

was how software always was.[1] (And if the kluges didn't exist, that was an achievement of applied anthropology—management—not digital technology per se.) Consequently, this made one skeptical about what might be called "big culture" representations of information and media—the kind that conjured holistic systems such as "digital culture," for example. Worse still, when eighties commentators sought to distinguish their "information revolution" from the earlier "age of print," they only exacerbated the problem. Print, they now said, had been everything the new Internet was not: where the Net was dynamic, interactive, and dubious, print had been stable, linear, and authoritative.

I now think that I found prevailing accounts of early print drastically unconvincing partly because they reminded me of those assertions about contemporary information. If you like, they were the Windows 3.1 of cultural theory: system-level patterns that were allegedly sufficient unto themselves, but in practice were extremely rickety. Somebody used to working "under the hood" of information technologies was accustomed, as a matter of everyday practice, to such assertions' divorce from reality. And in fact it didn't take a lot of work to start finding examples from the early modern period of printed works that were *well known* to be nothing like the standard representation. Books (Shakespeare's, for example) were various, inauthentic, tricky to trust, and put to unpredictable uses. I ended up arguing that these were not exceptions—as "big culture" accounts required—but the rule. Hence *The Nature of the Book*, which was largely an argument about how communities sought to intervene in the mundane practices of print so as to manage this situation.[2] I now think that this view of early modern information was thoroughly conditioned by distaste for the anti-historical and holistic bent of 1980s digital euphoria.

So my first rule of thumb would be this: Avoid "big culture" talk. That applies all the more when such talk is ubiquitous. I would then add that it's worth paying attention to the work—often local and small-scale—through which these apparently stable entities are built, maintained, challenged, and—perhaps above all—used.[3] Its elements include not just technical practices and skills, but more numinous things like perceptions of moral conduct—e.g., in the seventeenth century, ideas about how a master craftsman should properly behave.

But the third thing I would say is that in the end, excavating local, mundane, practical communities is not enough. The aim has to be to use these to explain how widely shared convictions arise about "the" nature of the Internet, or "print culture," or the inherently revolutionary character of digital networks—and the policies, practices, and actions that rest on those convictions. People who perceive big cultures and revolutions are not in any simple sense wrong. It's just that their perceptions are themselves complex historical entities. They are things to be explained. I do feel that historians have not been good at staking a claim to this subject. It is as though they

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[1] Neal Stephenson's "In the Beginning Was the Command Line" (1999), http://www.cryptonomi con.com/beginning.html, gives an impression of this mentality, although it represents a later period, when the moral claims of open-source software had become distinct in their own right.

[2] Adrian Johns, *The Nature of the Book: Print and Knowledge in the Making* (Chicago, 1998).

[3] I would add that approaches need not automatically center on the normal narrative of technological systems, with its stages of invention, consolidation, etc. Lisa Gitelman's *Always Already New: Media, History, and the Data of Culture* (Cambridge, Mass., 2006) is partly a polite counterpoint to this historiography of systems.

have been dazzled, partly by the real technological complexities involved, and partly by the grandiosity of the prevalent claims. It is interesting and revealing—and I suspect it ought to give us pause—that some of the most impressive historicist accounts of the information age have come from writers who are not professional historians at all.[4]

Lisa Gitelman: I think that one of the great pleasures of studying media history is the way it cuts against the exceptionalism of the present to which the Editor's question alludes.

I came to media history through historical editing, specifically the collaborative work of describing and publishing the papers of Thomas A. Edison. The Edison Papers project and the Edison archive helped to make me even more of a hardware geek than I already was (a mixed blessing), while it inspired a documentary sensibility—an interest in the papery stuff of the archive—that has persisted to this day. Like Adrian, I was frustrated by monolithic or "big culture" representations of technology. It didn't take more than a few moments at the Edison Papers to learn that categories like "the telegraph" and "the phonograph"—like "the book," as it happens—are broad to the point of near-uselessness, despite their ubiquity in popular discourse about media and the history of communication. Specificity is key. No technology is self-defining. Another revelation was the staggering variety of historical sources in even that one archive; we were reading documents as "texts" (as my graduate school professors would have said), but we were also attuned to a myriad of non-textual or less-textual uses of paper and paper-like media that were nonetheless meaningful to us as to the actors we studied. Having been trained in the business of analyzing literary works—those ethereal results of literary genius—this diverse world of material texts was a revelation, though I suppose it shouldn't have been. And if my new self-consciousness proved productive, then it has since seemed all the more important to attend similar sorts of self-consciousness within the historical record itself, to attend the circumstances in which people have experienced anew the conditions of their own communication or potential communication: moments of innovation, dispute, breakdown, transfer, and the like, moments in which the grounds of meaning itself seem to have been most clearly at stake.

Gabrielle Hecht and Paul Edwards: As Adrian says, it's not enough to simply avoid what he calls "big culture talk"—historians must also attend to the historical (cultural, political, social, local) specifics of force and power. We have sometimes used a related term, "rupture talk."[5] In the history of nuclear things, rupture talk narrated the advent of nuclear weapons or nuclear electric power as marks of a historical break, the dawn of a new era—here, "the nuclear age"—in which everything, everywhere, was forever different. Both popular and scholarly histories of information

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[4] E.g., Gabriella Coleman, "The Anthropology of Hackers," *The Atlantic*, September 21, 2010, http://www.theatlantic.com/technology/archive/2010/09/the-anthropology-of-hackers/63308/; Chris Kelty, *Two Bits: The Cultural Significance of Free Software* (Durham, N.C., 2008). Both Coleman and Kelty are anthropologists, yet both take care to relate the ethnography of current hackers et al. to relatively deep histories of liberal ideology and the like. Another, older example would be the journalist Steven Levy's classic *Hackers: Heroes of the Computer Revolution* (Garden City, N.Y., 1984).

[5] Gabrielle Hecht, "Rupture Talk in the Nuclear Age: Conjugating Colonial Power in Africa," *Social Studies of Science* 32, no. 5–6 (October–December 2002): 691–728.

technology often take the same tack; the codex, the printing press, the photocopier, the digital computer, and the World Wide Web have all been made to play that part.

In nuclear affairs, the idea of historical rupture served all kinds of ends (intentionally or not). For example, it offered a way of talking about world politics that made the superpower arms race the center of mechanisms intended to create and regulate global order, from the UN on down. Not incidentally, it was often accompanied by rupture talk concerning the end of empire. When these two modes were paired, they created the sense that nuclear weapons had *replaced* empire as a global ordering system, thereby helping to obscure both the continuities between colonized and decolonized periods and the connections between the persistence of imperial/colonial dynamics and the success of nuclear systems.

Rupture talk has many antecedents: think of railways, airplanes, or "the space age." Of course, periodizing of any kind always begins with this sort of move, which can usually be deconstructed in the ways Adrian describes. Yet there is something unique about the way in which rupture talk recurs around technology in the nineteenth and twentieth centuries. At its heart is technological determinism: a belief that the technology in question, whatever it is, impels particular outcomes, and that it will effect specific kinds of social change all by itself. Historians of technology (and other social scientists working in science and technology studies, or STS) have labored long and hard to dispel such notions. Yet it's true, as Adrian says, that they've spent rather less time on analyzing rupture talk (or "big culture" talk, or pervasive determinism) as a cultural phenomenon in its own right.[6]

We humbly suggest, however, that analyzing such talk ultimately offers limited rewards. Ruptures are partly a matter of perspective; things always (can be made to) look more orderly from afar than they ever appear up close, and claims to a new order often carry with them claims to power over that order, whether it's the weak power of intellectual comprehension (by historians) or the stronger powers of ownership, political action, etc. (by various actors). Ruptures are also matters of scale. The seven-billionth living person was allegedly born near the end of October 2011; by any standard, the amount of raw information in the world today is many orders of magnitude larger than when the printing press was invented, and the speed and quantity of communication today dwarf those of any previous era.[7] These are real and important changes (if not exactly ruptures). A genuinely historical approach to these things must acknowledge both the falsehood and the truth inherent in rupture talk. (As Adrian says, it's not wrong in any simple sense.)

One interesting approach, in our view, is uncovering what rupture talk hides (as

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[6] Yet some have done precisely that. See the essays by Merritt Roe Smith and Michael L. Smith in Merritt Roe Smith and Leo Marx, eds., *Does Technology Drive History? The Dilemma of Technological Determinism* (Cambridge, Mass., 1994). See also Thomas J. Misa, "How Machines Make History, and How Historians (and Others) Help Them to Do So," *Science, Technology, and Human Values* 13, no. 3/4 (1988): 308–331; and Paul N. Edwards, "Infrastructure and Modernity: Force, Time, and Social Organization in the History of Sociotechnical Systems," in Thomas J. Misa, Philip Brey, and Andrew Feenberg, eds., *Modernity and Technology* (Cambridge, Mass., 2002), 185–225. For an analysis of the cultural work done by "space age" talk, see Peter Redfield, *Space in the Tropics: From Convicts to Rockets in French Guiana* (Berkeley, Calif., 2000). For an analysis of how historical conceptions of the relationship between technology and politics shaped technological discourse in France, see Gabrielle Hecht, *The Radiance of France: Nuclear Power and National Identity after World War II* (Cambridge, Mass., 2009).

[7] Peter H. Lyman, Hal R. Varian, et al., "How Much Information? 2003," http://www.sims .berkeley.edu/how-much-info-2003.

per Adrian's second injunction). So what, we might ask, hides behind utopian proc-lamations about "the information age" or the unprecedented circulation of knowl-edge and information? As historians of the contemporary period, we wonder: What knowledge, in this era of supposedly free and frictionless circulation, *fails* to cir-culate? What do information and knowledge infrastructures enable, what do they fail to accomplish, and how can we explain both success and failure using similar analytic criteria?[8]

Indigenous, local knowledge, for example, often proves difficult to slot into the implicit conceptual boxes of contemporary database-driven information technology. Local practice still has to be learned through legitimate peripheral participation. Tacit knowledge and skill remain difficult to record.[9] Entire languages are being lost at an alarming rate. Clearly today's information infrastructures exclude a great deal, even as they create much that is new and collect and preserve much that would otherwise be lost.

This means we should be thinking not just about information *technology*, but about *knowledge infrastructures*.[10] Any system of knowledge, whether it be the in-digenous knowledge of oral cultures or the most sophisticated forms of scientific analysis, relies on robust, enduring techniques, technologies (even simple ones), practices, and recording methods. The phrase "knowledge infrastructures" may be off-putting to some, who may hear it as technophilic and react with allergy or horror, but to us it captures the simultaneously social and material basis of what we know—any of us, anywhere, anytime. Only if you think of knowledge as inert and perma-nently fixed, rather than as a living human creation that requires maintenance, ex-tension, and regeneration, can you imagine that it does not rely on some kind of infrastructure for its transmission, and indeed its very existence.

Neil Safier: I think our contribution as historians lies precisely in our ability to contextualize with reference to specific processes, actors, spaces, materials, and pe-riods, rather than reacting in knee-jerk fashion to the "harbingers of an entirely new age," and I am pleased to see such robust responses to this initial question. It seems to be clear to all of us that broad-brush characterizations of cultures as determined by a single form of technology or type of expression—such as an overarching digital culture or a particular technological age—leave much nuance, complexity, and his-torical specificity to be desired. Of course, we all have our own opinions about the precedents as well as the unprecedented aspects (and I believe there are both) in the way that information and knowledge circulate today—within and outside the university, in rich and poor nations, within democratic and authoritarian regimes, across political and linguistic borders, etc. As scholars, I think we also need to con-

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[8] Barry Barnes and David Bloor, "Relativism, Rationalism and the Sociology of Knowledge," in Martin Hollis and Steven Lukes, eds., *Rationality and Relativism* (Cambridge, Mass., 1982), 1–27; Michel Callon and Bruno Latour, "Unscrewing the Big Leviathan: How Actors Macro-Structure Reality and How Sociologists Help Them to Do So," in K. Knorr-Cetina and A. V. Cicourel, eds., *Advances in Social Theory and Methodology: Toward an Integration of Micro- and Macro-Sociologies* (Boston, 1981); Bruno Latour, *Aramis; or, The Love of Technology* (Cambridge, Mass., 1996); Latour, *Reassembling the Social: An Introduction to Actor-Network-Theory* (Oxford, 2005).

[9] Harry Collins, *Tacit and Explicit Knowledge* (Chicago, 2010).

[10] Paul N. Edwards, *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming* (Cambridge, Mass., 2010), esp. chap. 1.

sider the way that the forms of technology and material supports we use to share ideas today—screens and buttons, to take two obvious candidates—affect the way we learn from and communicate with one another. I don't personally have the expertise to make far-reaching comparative assessments between the specific contexts of my own work and many of the modern-day "systems" or "cultures" alluded to by my fellow conversation partners, but I do find the exercise fascinating and important.

As a historian of the non-contemporary world, I read the earlier responses thinking about how the study of early modern empires—acting in the period roughly from 1450 to 1850—may shed a distinctive light on the dynamics of information exchange and the connections between peoples, places, and ideas. As the Editor's initial question implies, there may be much to be gained from having a certain distance—temporal, geographic, or otherwise—between these processes and our own world, but what precisely? One way is through the study of uneven relationships in moments of encounter. Much of the historical literature on empire has sought to portray the overwhelming power of the early modern state in its relationship with subject peoples, be they members of lower social classes, bureaucrats and administrators, or indigenous populations. This emphasis on the seeming omnipotence of the state has been moderated in recent years through a better understanding of the dynamics of cross-cultural contact itself, whether through the transfer of material objects, linguistic exchange, mimicry, or resistance.[11] Through my own research, I have found that forms of knowledge, whether codified or not, apply pressure in variable, uneven, and often unexpected ways when they come into contact with one another. Vestiges of seemingly "subaltern" forms of knowledge often find their way into authoritative texts and hegemonic institutions through a back door that is not always signaled or made explicit. Local actors often play a central role in these transactions, but their specific contribution may be left unremarked or deliberately effaced. As Gabrielle and Paul remarked earlier, indigenous or local forms of knowledge fit uncomfortably into the modern boxes by which we might categorize or classify information systems today. I would propose that by looking closely at moments when early modern actors sought to understand one another on their own terms, including moments of bemusement, non-translation, and utterly incompatible systems of understanding, we can better grasp the conceptual mechanisms operating in the material and epistemological worlds of radically different groups and individuals.

Many of these encounters are mediated—then and now—through diverse textual and narrative formats, and this is another way in which the study of early modern encounters can be instructive. The fluidity and flexibility between different material formats, such as between manuscript and print, is one aspect of this complex.[12] Narrative conventions and linguistic manipulations are another. In a recent article, I

[11] Some important examples include Nicholas Thomas, *Entangled Objects: Exchange, Material Culture, and Colonialism in the Pacific* (Cambridge, Mass., 1991); Amiria Henare, Martin Holbraad, and Sari Wastell, eds., *Thinking through Things: Theorising Artefacts Ethnographically* (London, 2007); Frederick Cooper and Ann Laura Stoler, eds., *Tensions of Empire: Colonial Cultures in a Bourgeois World* (Berkeley, Calif., 1997), esp. their introduction; and Maya Jasanoff, *Edge of Empire: Lives, Culture, and Conquest in the East, 1750–1850* (New York, 2006).

[12] Here, in addition to Adrian's *The Nature of the Book*, the work of Fernando Bouza and François Moureau offers important examples of this fluidity: Bouza, *Corre manuscrito: Una historia cultural del siglo de oro* (Madrid, 2001); Moureau, *De bonne main: La communication manuscrite au XVIIIe siècle* (Paris, 1993).

referred to the "technologies of registration" by which colonial administrators, naturalists, and traveling clergy annotated and categorized new forms of knowledge in other parts of the world.[13] Other historians of colonial Latin America have shown how these same technologies of the written word came to be employed and adopted by indigenous populations throughout the Americas.[14] All of these studies, it seems to me, work toward allowing us to imagine different kinds of knowledge systems whose traces do not always end up as visible vestiges within the final versions of a text or even of a manuscript. In the end, it is a question of how portable ideas and information actually are, who ends up grasping and deploying them, and the extent to which certain social, cultural, political, and physical barriers conspire to impede their transmission.

Brian Larkin: The two clichés about innovations in media technologies are that everything is new and that nothing is. Technophiles emphasize rupture and the radical transformation brought by new technologies, while critics insist that what seems to be new is merely a repetition of similar processes from the past (that the telegraph is the Victorian Internet, for example). Both of these responses are reflexes rather than arguments. To develop historical understanding, it is right to question the emergence of categories such as "print culture," but it is not enough to use "history" as a means of dismissing technological determinism. In *Signal and Noise* I wanted to question universalist theories of media and technology by examining their historical emergence in Nigeria in the context of colonial rule and a modernizing Muslim society.[15] But to historicize information technologies, to me, involved asking hard questions about what power technologies have as technologies and how they enter into reciprocal engagement with political and social forces. The answer is not always clear, but it is because it is not clear that historical analysis is needed, and that is why I would be wary of dismissing analyses of the power of technologies as determinism. John Durham Peters has recently argued that "technological determinism" is a term used mainly by people seeking to attack others, and the danger of its use is that we create a caricature of scholars who believe that a single technology dominates social formation and historical change.[16] Thus summoned into existence, history is invoked to provide "context," "specificity," and "complexity," but in a sense this use of history is the opposite of historical understanding because it does not inquire into historical conditions. Most careful analysis, of course, lies in between these extreme poles, but the poles too often define the debate.

These questions are essential for history not just because all media have histories but because all history has media. There can be no history without written files,

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[13] Neil Safier, "Transformations de la zone torride: Les répertoires de la nature tropicale à l'époque des Lumières," *Annales: Histoire, Sciences Sociales* 66, no. 1 (2011): 143–172.

[14] See, for instance, Eduardo Neumann, "Escrita e memória indígena nas reduções guaranis: Século XVIII," *Métis: História & cultura* 6, no. 12 (2007): 45–64; and Serge Gruzinski, *La colonisation de l'imaginaire: Sociétés indigènes et occidentalisation dans le Mexique espagnol, XVIe–XVIIIe siècle* (Paris, 1988).

[15] Brian Larkin, *Signal and Noise: Media, Infrastructure, and Urban Culture in Nigeria* (Durham, N.C., 2008).

[16] John Durham Peters, "Two Cheers for Technological Determinism" (paper presented to the conference "Media Histories: Epistemology, Materiality, Temporality," Columbia University March 24–26, 2011).

books, records, pot shards, or religious icons, each with their own distinctive form—what media theorists would term their mediality. The distinctive nature of forms brings about different professional competencies needed to analyze them (the scientific analysis of an archaeologist, the iconographic analysis of an art historian, the textual and oral analyses of social historians). On the one hand, then, we have strikingly different material objects with distinctive features—this is not technological determinism, simply taking into account the particular distinction of media forms. On the other, these objects can only become historical data because we have a concept of "history," a concept that lies outside of those forms and in broader intellectual and political contexts. The difficulty, yet also the fascinating aspect, is thus to try to understand the interaction between technology and its broader intellectual, social, and cultural fields.[17] To my mind this is a difficult question, one surely pursued through the specific analyses called for (and practiced) by all the respondents, but one that requires us (me, at least) to be wary of slipping into binary distinctions between determinism and history that obscure as much as they reveal.

The exchange and circulation of knowledge relies upon media—bodies, parchment, paper, paintings, bytes—by which that knowledge is encoded and relayed. A basic insight of media theory, and one I adhere to, is that these means of storage and dissemination are not neutral vehicles simply transmitting data, but they actively shape the information they traffic. To think historically about information and circulation thus necessitates thinking about these media forms and the practices and modes of life they give rise to. To take an example from my research, it used to be in Muslim northern Nigeria that religious knowledge was transmitted through rote memorization. Students would travel to study with a particular *mallam* or teacher who had memorized a certain text and learn it from him. Frequently this took place within the confines of a particular Sufi order, so that to gain access to texts, one had to conform to the hierarchies and structures of Sufi Islam. Knowledge transmission thus involved an entire cultural complex. One had to develop techniques of memorization and audition (the media form, so to speak), but one also had to adopt the proper practices of deference seen as necessary for learning (one must take one's shoes off in the teacher's presence, avert one's eyes, never address a teacher directly, sit below him on the floor while he is raised on cushions, and so on). In this case, the practical techniques by which information is stored and relayed (memorization, audition) give rise to cultural practices and forms of life. One could pose a chicken-and-egg question as to whether the medial form (memorization) generates cultural techniques or vice versa, but in reality the two emerge in mutual interaction. It poses the question, how do we assess the relative influence between technologies and their historical contexts? To answer this necessitates taking seriously the idea that technologies have social power, even if it is to understand what the limits and borders of that power may be.

This is important in the study of Islam, as several scholars have used the concept of "print Islam" or "print culture" to contrast oral and scribal modes of Islamic transmission with print-based educational practices. These are, of course, precisely

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[17] An argument made well by Michael Warner in his essay "The Cultural Mediation of the Print Medium," in Warner, *The Letters of the Republic: Publication and the Public Sphere in Eighteenth-Century America* (Cambridge, Mass., 1990), 1–33.

the "big culture" concepts Adrian warns us to be wary of. Yet the work of someone like Brinkley Messick seems to me to pay attention precisely to local details and the broader cultural configurations of which print is a part while still arguing powerfully that this technology did indeed create a rupture or distinction from older Islamic practices.[18] And while I share Adrian, Paul, and Gabrielle's caution about the usefulness of a rupture theory of history and media, one should not push this too far. In the context of Muslim northern Nigeria, print did not come simply as a technology that pressed wet ink onto a page but as part of a fully blown print culture, which British colonialists used as an aspect of colonial rule. The creation of Western, print-based curricula was premised on a set of cultural beliefs in the rationalizing, modernizing, secularizing nature of print which were self-consciously deployed as part of the introduction of the medium. The ideology of print culture was as much a part of the technology as paper and ink. Moreover, the Salafi movements that constitute contemporary Islamic revival have adopted modern media and educational reforms as part of their movement-building practice and have invested heavily in the idea of what we might term print culture or print Islam. They use this innovation precisely to distinguish themselves from Sufi Muslims, whom they deride as being "backward" and "traditional," enacting rupture talk as a part of movement-building. This is why it is hard to easily rid ourselves of ideas of print culture or of rupture talk because it can form part of the very thing we are looking at. Neil is right to remind us that indigenous systems of knowledge can be incommensurate with modern ones, but the nature of the colonial encounter he is interested in means that these two are forced into a translational process with all the forms of power that accompany it.

Gitelman: I am struck by the high degree of consensus in the comments we're making. For all of the hugely different work that we do, the different disciplinary orientations and styles of inquiry represented among us, it seems like there are some values we share. First among them seems to be a sort of epistemic moderation, though perhaps the professorial way to say that would be, well, "It's complicated." So we pull out technological determinism as a problem we recognize, and then (I'm thinking of John Durham Peters's recent work, too) decline any fully anti-determinist position. Likewise the language of rupture. Plus the appeal of indigenous knowledges, the local, and the failed. We pull open the media concept to include so much, as Brian suggests, that its borders start to fade from view. That said, we can probably all think of work that hasn't shared these values, or that hasn't expressed their acceptance with either the sensitivity or precision we might like. Certainly there is a lot of scholarly work in media studies that—like the reigning popular discourse— remains profoundly ahistorical. *We* at least agree that history matters. Readers of the *AHR* may or may not be surprised to learn that this point is still being argued. It is being argued broadly in terms of support for the humanities, yes, but it is argued locally as well. In the field of media and communication studies, I have noticed that history tends to get pulled out as an option, as one item on a menu of possible "approaches." And I have even heard it welcomed by communication scholars as an "empirical" method, because of its recourse to archival sources. Partly for this rea-

[18] Brinkley Messick, *The Calligraphic State: Textual Domination and History in a Muslim Society* (Berkeley, Calif., 1992).

son, I am fascinated by the question Neil raises about what purchase the "screens and buttons" of today have on the work of history that we see ourselves doing. In particular, I've started to look at the textual materials I use and ask, "What am I seeing here that cannot be digitized?" or, if I'm staring at a screen, "What am I not seeing?"

Hecht and Edwards: It's been fascinating to read about media studies (about which we know little) and note the parallels with our home field of science and technology studies. Still, some of the replies make us suspect that our first posting may need clarification.

It's true that a lot of scholarly air has been exhaled on the subjects of "technological determinism" and "rupture talk." We completely agree that it isn't useful to set up straw scholars who purportedly see technological history as deterministic, full of ruptures, etc. So let's park that debate at the curb, shall we?

What's a lot more interesting is to explore how *historical actors* have *used* determinism and rupture talk in their own discourse and activity. Our point was precisely that these are elements of political and cultural discourse that need to be taken into account in any analysis of technological change and its cultural interpretations.

As we have written elsewhere, technological determinism and rupture talk acquired particular heft within the discourses of the Cold War. Brian notes that the ideology of print culture is part and parcel of its technology. Similarly, we've argued that technological determinism was part of U.S. defense strategy during the Cold War, and that the rupture talk which accompanied France's search for uranium in Africa masked the persistence of colonial dynamics in the postcolonial era. On a counter-note, the success of the French nuclear program is partly explained by the fact that its engineers adopted a *deliberately technopolitical* approach to program building—rather than a simple technological determinism, as they might have done had they emulated their American counterparts.[19]

From "the computer revolution" to "the information age," rupture talk is among the most common tropes in post–World War II information technology. Much of this is mere marketing—but believing one's own hype is another depressingly typical feature of contemporary infoculture. It's worth noting that IBM, which dominated digital electronic computing worldwide for thirty years, was an office machine manufacturer whose roots go back to the 1890s. The company's rhetoric was revolution, but its practice was very much evolutionary.[20]

All of which may leave us in even deeper consensus, as Lisa notes . . . Which, in turn, only increases our desire to move the conversation in other directions. Perhaps we could explore links (and frictions?) between our comments about knowledge

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[19] In addition to the works cited in our first post, see Paul N. Edwards, *The Closed World: Computers and the Politics of Discourse in Cold War America* (Cambridge, Mass., 1996); Gabrielle Hecht and Paul N. Edwards, "The Technopolitics of Cold War: Toward a Transregional Perspective," in Michael Adas, ed., *Essays on Twentieth Century History* (Philadelphia, 2010), 271–314; Gabrielle Hecht, "Technology, Politics, and National Identity in France," in Michael Allen and Gabrielle Hecht, eds., *Technologies of Power: Essays in Honor of Thomas Parke Hughes and Agatha Chipley Hughes* (Cambridge, Mass., 2001), 253–294.

[20] Emerson W. Pugh, *Building IBM: Shaping an Industry and Its Technology* (Cambridge, Mass., 1995); Manuel Castells, *The Rise of the Network Society* (Cambridge, 2000); James R. Beniger, *The Control Revolution: Technological and Economic Origins of the Information Society* (Cambridge, Mass., 1986).

infrastructure, Brian's point that "all history have media," and Neil's comments about screens and buttons?

AHR Editor: As Lisa notes, there seems to be a high level of consensus here, especially in terms of wishing to avoid "big culture" and "rupture" talk, technological determinism, and approaches that glide over local variations, asymmetry in exchanges, the specificity of various "media," and, of course, history. Among other comments, I am struck by Brian's warning that "it is not enough to use 'history' as a means of dismissing technological determinism." And this, in turn, suggests a line of inquiry that might help us understand better what we mean by technology in the context of information exchange. On one level, we have two very elastic terms, "media" and "infrastructures," which include but are not limited to what we usually mean by technology; they also mean much more. Indeed, deploying them would seem to have the intent precisely *not* to be trapped into privileging the technological in the modern or even contemporary sense over other modes of exchange, communication, reproduction, and the like. Still, I'm wondering if we shouldn't press for distinctions that are essentially historical in character. One way, which several comments evoke, is to be sensitive to what gets lost, suppressed, or otherwise compromised either in the process of technological change or when there is an asymmetrical encounter between cultures with very different media practices or infrastructure resources. Often cited in this sense is the "loss" of memory techniques with the advent of print or the obliteration of regional or local languages and/or vocabularies with their rich inventory of words or expressions. (Here, too, however, it might seem as though we're buying into another narrative that risks configuring our understanding in ways that obscure the historical nature of things—a dark version of modernization where instead of "progress," enlightened cosmopolitanism, and improvement we have loss, cultural homogenization, and in general the denial of people's agency.) Without embracing the notion of technological determinism, how might we think about the weight and force of new media techniques and practices as they work their way into people's lives, often challenging or reshaping the infrastructural landscape of their cultures?

Gitelman: That's a tricky question and a rich one. Taking just the one about what you call "technology in the context of information exchange," we're dealing with one concept that emerged in the course of the nineteenth century (technology) and another that emerged in the course of the twentieth (information), if I can stick to the Anglo-American contexts I know, not denying there are others. Cultural and historical specificity seems key. When I tackle questions like these, I tend to turn to the work of the rest of you, to be honest, as well as to Leo Marx's article on the emergence of technology as what he calls "a hazardous concept."[21] (John Guillory has a recent and illuminating meditation on the origins of "the media concept," which I also recommend.)[22] Marx points to "technology" as a keyword in Raymond Williams's sense, a term that comes to have its present meaning in the course of the

[21] Leo Marx, "Technology: The Emergence of a Hazardous Concept," *Social Research* 64 (Fall 1997): 965–988.
[22] John Guillory, "Genesis of the Media Concept," *Critical Inquiry* 36, no. 2 (Winter 2010): 321–362.

very developments it is used to describe. So the modern concept of technology emerged—in the Anglophone world, at least—in concert with the large socio-technical systems of the nineteenth century within which "material component[s]" became the "tacit referent."[23] Not an uncomplicated process, with certain hazards, as Marx says.

I suspect that this same sort of reflexive thinking might help us think about the ways that new media "work their way into people's lives." If media are like keywords, that is, their uses help to organize the very meanings they are used to communicate as such, that is, as meanings. (I'm trying to avoid the mathematized "information," in favor of "meaning.") Meaning and media are mutual projects, if you like. We get a longer view of our subject if we think of new media in terms of the ways that people experience the presence of meaning and the qualities of meaningfulness, the ways in which meanings are delimited, transmitted, or preserved. New media are sites of necessary self-consciousness about communication and communicability in these terms.

Hecht: First, I'll briefly add to Lisa's comment about "technology" as a keyword. Some of the scholarship I've found most provocative on this topic comes from historians of technology who think about gender, race, and class. Writing about nineteenth- and early-twentieth-century America, for example, Nina Lerman and Ruth Oldenziel have shown how the notion of "technology" became distinct from other designations (such as "the practical arts") and acquired the industrialized, masculine, white, middle-class connotations that came to characterize its deployment. In thinking about what "technology" has meant, and how those historical meanings changed, they argue, we need to be mindful of what (and whom) "technology" excludes.[24] Such arguments are equally salient when analyzing colonial/imperial dynamics, where the question of who was (or could be, or should be) a meaningful technological agent was, among other things, a question of power.[25]

When it comes to new media, that line of inquiry takes us, most immediately and obviously, to questions concerning how difference(s) shape access to, and use of, media. Who has access to which new media? What local, regional, national, transregional, global infrastructures limit or mediate access? Which differences shape use, how, when? Et cetera—I'm sure we can all generate a dozen such questions. While I can generate the questions, I can't offer detailed responses. ("Not my field!" cries the historian.)

But I also wonder whether we can separate content from (infra)structure. How does the *content* of the information being transmitted matter in shaping both the

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[23] Marx, "Technology," 979.

[24] Nina E. Lerman, "Categories of Difference, Categories of Power: Bringing Gender and Race to the History of Technology," *Technology and Culture* 51, no. 4 (October 2010): 893–918; Ruth Oldenziel, *Making Technology Masculine: Men, Women, and Modern Machines in America, 1870–1945* (Amsterdam, 2004); Nina E. Lerman, Ruth Oldenziel, and Arwen Mohun, eds., *Gender and Technology: A Reader* (Baltimore, 2003). On the meanings of "technology," see also Eric Schatzberg, "Technik Comes to America: Changing Meanings of Technology before 1930," *Technology and Culture* 47, no. 3 (July 2006): 486–512; Marx, "Technology."

[25] See, for example, William Kelleher Storey, *Guns, Race, and Power in Colonial South Africa* (Cambridge, 2008); Angela Lakwete, *Inventing the Cotton Gin: Machine and Myth in Antebellum America* (Baltimore, 2003).

transmitting media's technologies (here I use "technology" not as an actor category but as an analytic category, one understood broadly as hardware *plus* sociocultural practices) and access to those technologies? Perhaps this is one way of getting at meaning, as per the second part of Lisa's comment. I'm guessing that media theorists take on these issues (and probably have more sophisticated ways of framing the questions).

In my case, such questions stem from thinking about knowledge infrastructures more broadly. In looking at the technopolitics of occupational exposures in African uranium mines, for example, I found that scientific instruments, labor relations, scientific disciplines/knowledge, expert controversy, and lay knowledge combine to create what Michelle Murphy has called "regimes of perceptibility"—assemblages of social and technical things that make certain hazards and health effects visible, and others invisible.[26] Knowledge about disease and exposure—both scientific knowledge and the "lay" knowledge of suffering workers—was inextricable from such regimes and the power relations that they enacted. Which isn't to say that such power relations were fixed in place by technologies, of course. In the 1950s and 1960s, such regimes rendered exposures invisible in Gabon, Madagascar, and South Africa. But beginning (slowly) in the late 1970s, and really taking off in the 1990s, proliferating systems of knowledge-making and knowledge distribution broadened the perceptibility of exposure and disease, although in significantly different ways for workers, managers, and scientists. Those differences had a lot to do with the content of the knowledge in question. In other words, matters such as the political and cultural valence of "nuclear" knowledge, or tensions among different communities over the production of knowledge about radiation exposure, inflected the infrastructures and practices of knowledge-making and distribution.[27]

Edwards: One of the most interesting early reflections on the changes associated with the World Wide Web was James J. O'Donnell's remarkable book *Avatars of the Word* (1998).[28] O'Donnell is a classics professor who somehow ended up as vice provost for information systems and computing at the University of Pennsylvania during the tumultuous 1990s. *Avatars* works its way through a series of major changes in the materiality of words, from Plato's famous *Phaedrus* (on orality vs. writing itself) to the codex book, the printing press, and the World Wide Web. He chronicles their reception by scholars who lived across these infrastructural divides. In every case, excitement about new possibilities seems always to have shared the stage with serious worries about the erosion of hard-won, cherished skills, the erasure of memory, the democratization of authority, and the physical fragility and intellectual ephemerality of each new medium in its turn. Many medieval codices, written on parchments made from animal skin, have survived for over a thousand years. Compare that to the lifetime of a paperback book, and then try to imagine your iPod lasting that long—much less the contents of your Twitter account.

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[26] Michelle Murphy, *Sick Building Syndrome and the Problem of Uncertainty: Environmental Politics, Technoscience, and Women Workers* (Durham, N.C., 2006).

[27] Gabrielle Hecht, "Africa and the Nuclear World: Labor, Occupational Health, and the Transnational Production of Uranium," *Comparative Studies in Society and History* 51, no. 4 (October 2009): 896–926.

[28] James J. O'Donnell, *Avatars of the Word: From Papyrus to Cyberspace* (Cambridge, Mass., 1998).

But the Editor's question points us toward the histories of how new media were used and received—by whom, for whom, at what cost, to whose benefit. Speaking to what I know most about, I'd point to the reception of electronic digital computers when they first appeared in the 1950s. Computers are quintessentially language machines; they transform symbols into other symbols. Yet few contemporaries understood computers as all-purpose communication devices. Instead, they saw them initially as giant calculators, tools for an elite corps of scientists. Commercial machines were likewise first imagined as number-crunchers, for horse racing (calculating bets and odds), insurance, and accounting, but not much else.

Next to rise to prominence was computers' facility as control systems. Here again they were imagined as tools for an elite, this time of engineers and managers. Computers transform symbols (programs) into actions, controlling both their own operations and those of many other devices, and along with this capability—and the way it was first implemented in factories and offices—came a widespread fear that they might automate away jobs, creativity, even thought itself.

A few visionaries aside ("visionaries," of course, only in hindsight), the possibility of using computers as all-purpose communication devices did not really emerge until the 1970s—and only took on its full force with the arrival of the Internet in the 1980s and the Internet's release for commercial uses in the early 1990s.[29]

20/20 hindsight, again: today we understand and use computers *primarily* as communication tools. Here we all are, typing our responses to these questions on little keyboards, staring at glowing screens. We see the Internet as a medium—yet the earliest developers of computer networks thought of them mainly as a way to share programs and data, hence avoiding redundancy among expensive computer centers. Again, they were imagined as tools for a tiny elite. The overwhelming popularity of mundane e-mail on the early ARPANET came as a great surprise. Today we experience the World Wide Web as a kind of inevitable juggernaut, engulfing virtually every other kind of communication, including radio, TV, and telephone—yet for its developers at CERN, in the late 1980s, it was really just the World Wide *Physics* Web, a way to take some of the strain off the CERN post office by letting physicists in Japan and North America download documents and data.[30]

Despite breathless claims about its uniqueness, the Internet exhibits much the same periodicity of growth, adoption, and build-out as canals, roads, railroads, telephone, and television. (That period, by the way, is around forty to sixty years.)[31]

I guess I do think there are important, strikingly consistent patterns in the construction and reception of new media, or new information infrastructures, in the

[29] Edwards, *The Closed World*; Janet Abbate, *Inventing the Internet* (Cambridge, Mass., 1999); Martin Campbell-Kelly and William Aspray, *Computer: A History of the Information Machine* (New York, 1996); Fred Turner, *From Counterculture to Cyberculture: Stewart Brand, the Whole Earth Network, and the Rise of Digital Utopianism* (Chicago, 2006).
[30] Tim Berners-Lee and Robert Cailliau, "WorldWideWeb: Proposal for a Hypertext Project," European Particle Physics Laboratory (CERN) (1990), http://www.w3.org/Proposal; James Gillies and Robert Cailliau, *How the Web Was Born: The Story of the World Wide Web* (New York, 2000).
[31] Arnulf Grübler and Nebojša Nakićenović, "Long Waves, Technology Diffusion, and Substitution," International Institute for Applied Systems Analysis, Laxenburg, Austria (1991), http://www.iiasa.ac.at/Admin/PUB/Documents/RP-91-017.pdf; Arnulf Grübler, "Time for a Change: On the Patterns of Diffusion of Innovation," *Daedalus* 125, no. 3 (1996): 19–42.

nineteenth and twentieth centuries.[32] And I would not be surprised to find much the same patterns in the more distant past, and across less familiar media.

Johns: For me, the key part of this question is the first part, about wanting to identify some specifically *historical* way to proceed. One response that I think worth making concerns something so basic to historical sensibilities that one often forgets about it altogether: chronology. After all, how we divide up the past into distinct chunks is inseparable from what we think distinguishes the chunks from each other, and one of the great assets of thinking in terms of distinct media cultures (oral, manuscript, print, digital, etc.) is that doing so immediately furnishes a convenient chronology (the digital age follows the age of print, and so on). We use this to divide up the past and our professional responsibilities alike, in a minimally contentious way, thus allowing us all to work and get along. Some ultimate appeal to self-evidence like this is a pretty fundamental element of historical knowledge of any kind (and perhaps other kinds of knowledge, too: Peter Dear's book *The Intelligibility of Nature* argues along these lines).[33] Our last round of discussions necessarily carries implications for these fundamental chronologies—in fact, it undermines them quite radically. I suspect that an answer to the question of the historian's role may lie in attending explicitly to chronologies.

Then I think I would want to point out (but, being me, I would say this) that there are big chronologies and small. The big ones are the chronologies of "ages" (the age of print, the digital age, the information age). We can't do without these, although any particular one is in principle fragile; long usage, as much as anything else, is what confirms them. The small ones, though, are more variable and therefore remain actively useful for thinking with. These are the chronologies of things, practices, media devices, and the like, measured in days, months, and years rather than decades and centuries, and overlapping rather than discrete. They deserve to be attended to because they underline why "technological determinism" is an untenable position. Not to flog a dead horse, it's untenable not because determinism per se is false, but because the concept of technology implicit in the phrase is achronological. In reality, a technology is never self-sustaining enough to undergird the kind of work one might want the phrase to do. That is true even of the big network technologies that have tended to define the terms that historians of technology use: think of the decay that would consume the highway system or the grid without constant intervention (and that is in fact consuming them in places like Detroit). Technologies, and therefore the infrastructures or cultures they foster, always have small chronologies; they are constantly shifting under pressures social, cultural, political, natural, and, indeed, technological. The example of the computer is perfectly apposite: within a few decades, the very identity of this technology changed beyond all prediction. What outcomes could such a technology determine?

I think this bears directly on the uneasy sense we have—and I share it—that, regardless of our fretting over analytic categories, people experience media as in-

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[32] Paul N. Edwards, "Y2K: Millennial Reflections on Computers as Infrastructure," *History and Technology* 15 (1998): 7–29; Paul N. Edwards, Steven J. Jackson, Geoffrey C. Bowker, and Cory P. Knobel, *Understanding Infrastructure: Dynamics, Tensions, and Design* (Ann Arbor, Mich., 2007).

[33] Peter Dear, *The Intelligibility of Nature: How Science Makes Sense of the World* (Chicago, 2006).

trusive "forces" impinging on their cultures. My feeling is that a response to this anxiety may be that there are historiographic—chronological—problems on both sides. The "recipient" culture is too easily characterized as timeless in one sense, and the "intrusive" technology as timeless in another. What needs to be insisted upon is that both characterizations of timelessness, roughly anthropological and technological, are false. That's a role for the historian that no other figure in our culture is going to take on. And it is both intellectually proper and practically consequential, because it may change the state of affairs.[34]

Edwards: I just can't let Adrian's lovely response go by without a quick reply. One of the things I teach in my course on history and theory of infrastructure is this: infrastructure is all about maintenance. Maintenance, maintenance, and more maintenance.[35] It doesn't just get built, like some colossal monument left to stand until natural forces wear it away. It constantly has to be repaired, rebuilt, extended, shrunk, adapted, readapted, continually redefined and reengaged.[36] Infrastructures are complex adaptive systems (to borrow another piece of achronological jargon). Not only are they made of many interacting parts, all of which are periodically changing and continually adapting to each other, but they are also embedded in and overlaid across cultures, organizations, governments, and other social forms, which interpret, alter, and erode them.

And finally, they interact with each other. The German sociologist Ingo Braun has a nice concept of "second-order infrastructures," by which he means new infrastructures assembled by opportunistic recombination of existing ones; his example is the European organ transplant network, built almost entirely from bits of emergency services, hospitals, information technology, and transport networks.[37] Such examples are easily multiplied.

What's specifically historical about this idea? (Maybe I'm only repeating what Adrian just said.) If you focus on the maintenance, instead of on the "thing," your attention is drawn to the mutual adaptations, the contingencies, the lucky successes and the abject failures—the things that disappear from view most of the time. Pipek and Wulf coined a verb—"infrastructuring"—to describe this continuous process of mutual adaption at all scales.[38]

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[34] Incidentally, there's a marvelous book by Daniel Rosenberg and Anthony Grafton that traces the intersecting histories of chronological work and representational techniques from the ancient world to modernity: *Cartographies of Time: A History of the Timeline* (New York, 2010).

[35] Geoffrey C. Bowker, *Memory Practices in the Sciences* (Cambridge, Mass., 2005); Geoffrey C. Bowker and Susan Leigh Star, *Sorting Things Out: Classification and Its Consequences* (Cambridge, Mass., 1999); Stephen Graham and Simon Marvin, *Splintering Urbanism: Networked Infrastructures, Technological Mobilities and the Urban Condition* (New York, 2001); Paul N. Edwards, Geoffrey C. Bowker, Steven J. Jackson, and Robin Williams, "Introduction: An Agenda for Infrastructure Studies," *Journal of the Association for Information Systems* 10, no. 5 (2009): 6.

[36] Stephen Graham and Nigel Thrift, "Out of Order: Understanding Repair and Maintenance," *Theory, Culture & Society* 24, no. 3 (2007): 1–25.

[37] Ingo Braun, "Geflügelte Saurier: Zur intersystemische Vernetzung grosser technische Netze," in Ingo Braun and Bernward Joerges, eds., *Technik ohne Grenzen* (Frankfurt am Main, 1994), 446–500.

[38] Volkmar Pipek and Volker Wulf, "Infrastructuring: Toward an Integrated Perspective on the Design and Use of Information Technology," *Journal of the Association for Information Systems* 10, no. 5 (2009): 447–473.

Gitelman: I think you're right, Gabrielle, that my appeal to meanings instead of information was a sidelong appeal to the problem of "content" as such, without wanting to accept the limitations of the tired message and medium dichotomy. We want the sense of ongoing-ness that Paul is getting at. I love Adrian's suggestion that the historian's role is to reveal and critique the ways that the concept of technology introduces chronological or achronological biases at different registers. We see this so clearly in the history of computing that Paul renders, and it makes perfect sense in thinking of the work I've done on early recorded sound.

There's the additional wrinkle, too—and here I'm picking up on what someone wrote earlier about concepts used by historical actors themselves—that the putative timelessness of "recipient" cultures, on the one hand, and "intrusive" technology, on the other, is complicated by the ways that experiences of mediation themselves tend to involve experiences of temporality, of historicity. So writing about the early history of recorded sound, broadly conceived, involved thinking about ways people have experienced save-ability, the tacit sense of what can be saved, what should be saved and how. Media or infrastructures are always *of* as well as *in* the historical record.

Larkin: It seems two main issues are emerging (probably based on our research interests) and which we might do well to disentangle. One is, what happens when technological forms change over time? This raises issues about the emergence of new technologies, the contexts that produce them, their impact on existing technologies and practices, and so on. The second issue is, what happens when there are, to quote the Editor, "asymmetrical encounter[s] between cultures with very different media practices"? This raises related yet differing sets of questions. Oftentimes the technologies involved are not "new," in that their technical capabilities are well understood and the epistemological assumptions affixed to them are well established. The issue of emergence, of the "coming to be" of a technology written about so well in the research of Lisa, Adrian, and Paul, is less at stake, or, more properly, is differently at stake. Print may not have been a new technology at the turn of the twentieth century in Europe, for instance, but for many Nigerians, the experience of it very much was. The issues raised here are ones of difference, translation, and incommensurability, the encounter between differing modes of ordering knowledge, and the connection between scientific projects or media forms and modes of political (colonial, postcolonial) rule. There is still a "coming to be" of technology, but this is not because the technology is itself emergent but because establishing systems of education or bureaucracy or science is a process of *translation* that emerges from the situations of encounter. There is a difference of emphasis here—present in different ways in the work of Neil, Gabrielle, and myself—that might have differing consequences.

This is why our concerns might not quite coincide. Adrian, for instance, is interested in breaking apart the concept of "print culture" by emphasizing shifting, open-ended practices that print technologies emerge out of and which only over time get hardened into the reified idea we have of print. Lisa's work similarly examines the introduction of technologies when their meanings and uses are not yet fixed. I too am interested in these processes of emergence, but in the context of colonial Nigeria, the epistemological assumptions and technical processes of print are well

established. They form *part of* the translational dynamic at stake in the encounter between empire and subject. In this situation, my interest is not in using history to undermine the reification of print (or radio, or digital media) but in historically analyzing how that reification is put to use in a situation of encounter.

As a way to sidestep the question of technology and its genealogy, I would like to return to our broader question of how it is that societies store and circulate information. All societies store information by organizing material or media forms—written journals, printed texts, songs, petroglyphs . . . — into a system. Neil's article on the epistemological incommensurability separating Amerindian knowledge systems and European science points to the differing nature of these information orders.[39] As he consistently notes there, modes of knowledge are encoded into forms by which they can be stored and represented. These range from the scientific journal of a European traveler to a cord tied with knots by an Amerindian informant to represent a map. One can refer to these material processes in differing ways: as objects, technologies (though, as Lisa and Gabrielle remind us, the latter term comes freighted with baggage), or, the term I most use, media. The common issue is that all of these refer to the material forms by which knowledge is organized and relayed.

Christopher Bayly, in his book *Empire and Information*, refers to these systems as information orders—a mix of technologies and knowledge systems.[40] There are many such information orders in any society, but his analysis of the relation between British rulers and Indian subjects focuses on three: the secular colonial circulation of information via bureaucracy, print, and telegraph; the traditional information orders of holy men and women, doctors of Hindu and Muslim law, pilgrimages, and so on; and the new class of scribes and translators who mediate between the two.[41] Because these were separate spheres, demanding different linguistic competencies, different ritual knowledge, and different technical skills, he argues that there were "zones of ignorance" between the communities where the two could not enter into each other's worlds. But he also points out that there were points of mutual overlap where systems created by the British could be adopted and used by Indian subjects. This is an idea explored by Engseng Ho in his study of the Yemeni Hadrami diaspora and the ways in which their movements over the Indian Ocean often entered into competition and interaction with various European empires.[42] Ho argues that Hadramis certainly had their own information orders based on genealogies, pilgrimages, grave visitations, and the like, but that they also traveled along the same roads, made use of the same postal system, and sailed on the same sea routes as the British, even if these technologies were not introduced with Hadramis in mind. This idea moves us away from understanding one technology as replacing another, and complicates the linearity we all feel uncomfortable with that technologies are supposedly in a long line of succession, with each new one overcoding the previous. It points toward a

[39] Neil Safier, "Global Knowledge on the Move: Itineraries, Amerindian Narratives, and Deep Histories of Science," *Isis* 101, no. 1 (2010): 133–145.

[40] C. A. Bayly, *Empire and Information: Intelligence Gathering and Social Communication in India, 1780–1879* (Cambridge, 1996).

[41] One can read Rudyard Kipling's novel *Kim* precisely as a novel about these competing information systems.

[42] Engseng Ho, *The Graves of Tarim: Genealogy and Mobility across the Indian Ocean* (Berkeley, Calif., 2006).

historical analysis of the ways in which these systems were both separate and entangled as they operated over time.

Safier: Prior to Brian's latest and very lucid response, which I thought did an excellent job of bringing together our collective concerns, I had been feeling increasingly hesitant about being pulled into a conversation about twentieth-century "media" and "infrastructures," since, in addition to extending beyond my professional competencies ("Not my period!" cries this historian), I am always cautious about importing words that are loaded with contemporary meaning into discussions of the past, especially when we use them to describe forms of communication, perception, and understanding to which we do not necessarily have privileged access. Using any kind of terminology as a metaphor for larger processes begs interrogation, of course, and also brings with it certain challenges. One of the questions that I always ask myself is why certain terms—"circulation," a current buzzword in the history of science; "infrastructure," a favorite among many members of this conversation; and numerous others we might name—come into vogue and become dominant metaphorically (metaphorical determinism?) in academic culture, and what the temptations and pitfalls are in using them. On the one hand, they are necessary to communicate with one another because they seem to provide some common ground; on the other hand, they require advocacy and mediation to be properly understood, without which they run the risk of saying everything or nothing at all. It's also interesting to consider, as Brian said, why our own conversation might have splintered into different threads according to our own areas of specialization. Perhaps that itself is an insight we can take into account as we try to understand how individuals, groups, and societies communicate with each other and integrate other/others' technologies into their own discourses and modes of understanding.

In order to explore this idea further and to respond more specifically to the question about new media techniques and practices, I wanted to recuperate yet another term that has been freighted with contested meaning over the course of its long history, from the early modern period to its reemergence in the early twentieth century. That term is "anthropophagy," which came into use at a time when Europeans were discovering cultures that were reported to consume human flesh in ritual sacrifices in the Americas. Contemporaneously, in Europe, Huguenots and Catholics were butchering each other and being forced to eat the carcasses of their own compatriots in order to survive the violent sieges that convulsed northern Europe during the wars of religion. The images of limb-eating cannibals that circulated in the works of the Protestant Dutch engraver Theodor de Bry, based upon Hans Staden's *Warhaftige Historia* (1557), among other texts, solidified this image of a people who wielded the technology of the barbecue to roast their enemies before consuming them.[43] Now let us fast-forward several centuries to Brazil in the 1920s (the same decade, if the *OED* is not mistaken, in which the word "infrastructure" came into use for the first time in English). The Brazilian notion of cultural anthropophagy, coined by the São Paulo intellectual and concrete poet Oswald de Andrade, was used to describe what Andrade felt was a particularly Brazilian cultural style, originating

[43] See *Hans Staden's True History: An Account of Cannibal Captivity in Brazil*, ed. and trans. Neil L. Whitehead and Michael Harbsmeier (Durham, N.C., 2008).

in the indigenous cultures encountered by the Portuguese early in the sixteenth century, but not in any way meant to be limited to them. Andrade reached back to a concept that Europeans had found abhorrent—the practice of eating one's enemies—and transformed it into something that he proclaimed to be culturally singular to Brazil: the transmutation of other cultures into Brazil's own, the idea that *the* defining aspect of Brazilian culture was in fact the appropriation, digestion, and deployment of other cultures. "Tupy or not tupy, that is the question," he famously wrote in his "Manifesto antropófago," published in 1928, placing Shakespeare regurgitated into the figurative mouth of a Tupinambá Indian of coastal Brazil. In another iconic poetic image, Andrade described a Tupinambá strumming a lute.[44]

Andrade's idea of cultural anthropophagy is relevant, I would argue, because it effectively captures the relationship between "technology" and other forms of human practices and beliefs, be they literary, religious, political, or musical. How is it that the incorporation of technology or new media differs from any other cultural system, if at all? Is there any particular reason we should be privileging "technology" as a conveyor of ideas, information, or meaning? How might the history of the introduction of cultural metaphors such as anthropophagy, I wonder, help us to understand how different cultures over time interpret their own incorporation of the meaning(s) of others?

Bringing the conversation full circle, I believe that the idea of cultural anthropophagy might also be relevant for how indigenous cultures consume and incorporate Internet technologies into their own communities, one of the rapidly expanding areas of current scholarship in Brazil. The first indigenous symposium on the use of the Internet in Brazil took place last November (2010), and master's theses and dissertations are popping up left and right in order to address the role and function of government-sponsored *pontos de cultura* (culture kiosks), an initiative by the Brazilian Ministry of Culture to provide Internet access to underserved communities. Following the work of Donna Haraway, one scholar has referred to users of these spaces as "indigenous cyborgs" who have reconstructed themselves and their own communities ethnically through the use of technology, enabling them, in her words, to create "significant forms of auto-representation and protagonism . . . without the mediation of a single institution."[45] For the last twenty-five years, the not-for-profit non-governmental organization Vídeo nas Aldeias (Video in the Villages) has had as its goal to "support the fight of indigenous groups to strengthen their identities as well as their territory and cultural legacies by means of audiovisual resources."[46] Following a program to distribute video cameras to members of various indigenous groups, more than seventy films are now available through their website. Even more recently, in the Upper Xingu (State of Mato Grosso), a group known as the Yawalapiti, which was largely thought to have become culturally extinct after centuries of biological, economic, and linguistic assaults by Western society, is now in the process of reconstituting its own cultural identity online.

All of this brings us back to the issue of chronology and historicity (and, I would

[44] Oswald de Andrade, "Manifesto antropófago," *Revista de Antropofagia* 1, no. 1 (May 1928): 3, 7.

[45] Eliete da Silva Pereira, "Ciborgues indígen@s.br: Entre a atuação nativa no ciberespaço e as (re)elaborações étnicas indígenas digitais," in *II Simpósio Nacional da Associação Brasileira de Pesquisadores em Cibercultura*, 2 vols. (São Paulo, 2008), 1: 135–152.

[46] http://www.videonasaldeias.org.br/

add, the problematic notion of instantaneity, about which I would love to hear others' comments, too). We know that native cultures in the Americas—and this is certainly true for aboriginal cultures elsewhere as well—had highly developed if differing notions of temporality at the time of contact with Western society, and that their ideas did not map easily onto the Gregorian calendar or onto our own received notions of time and history.[47] Suddenly, however, with the connectedness of the Internet and the potential for near-instantaneous communication across vast spaces, tropical or otherwise, these alternative temporalities run the risk of being folded into the global clock that ticks away incessantly at the top of nearly every web page and computer screen (we're back to screens and buttons). Native groups in Brazil such as the Povos da Floresta (People of the Forest) and Indios na Rede (Indians on the Web) have taken to using the Internet to reinforce the importance of storytelling within their own communities, sharing videos of interviews that discuss their history, recording sounds of disappearing languages, etc. What I think is interesting for our purposes is that these groups are—in anthropophagic fashion, par excellence—claiming this technology as their own and using a medium that might be seen as permanently transforming their own cultural frameworks to redeem and reconstitute that culture.

AHR Editor: We have, I think, covered a lot of ground and gone in several directions. Throughout, we have been warned about accepting concepts such as "technology" as timeless or value-free or as a "thing" rather than part of a process that needs ongoing maintenance. One direction I would like to pursue was raised by Gabrielle's question: "How does the *content* of the information being transmitted matter in shaping both the transmitting media's technologies . . . and access to those technologies?" My fear is that this might come dangerously close to falling into the tired (but still interesting?) dictum "The medium is the message," only in reverse. But is it worth considering for the moment whether indeed "the message is the medium"? It may be, as Paul reminds us in the context of the development of digital computers, that the presumed "content" for some innovations is one thing, while its actual usage turns out to be quite something else. And this suggests in turn a question that has to be relevant when discussing "information" or "knowledge" in any period—the degree to which it is esoteric, privileged, deliberately illegible, or otherwise removed from general understanding or even perception. How much has this been a part of the story of the exchange or circulation of information? And how much has "technology" either served or undermined this tendency?

Larkin: I have some responses both to this question and to Neil's last comments. The material turn in media theory and science studies does indeed raise the question of what place content now plays and how we think of it. The emphasis on materiality was partly a corrective, a desire to interrupt the sense that information simply "flows" in an unfettered, instantaneous way (a particular problem of work in digital media). The aim was to refocus attention on historical processes (social, technological) whereby information is produced by particular actors, encoded on specific technol-

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[47] For two recent edited collections that address this theme, see Carlos Fausto and Michael Heckenberger, eds., *Time and Memory in Indigenous Amazonia: Anthropological Perspectives* (Gainesville, Fla., 2007); and Neil L. Whitehead, ed., *Histories and Historicities in Amazonia* (Lincoln, Neb., 2003).

ogies that allow them to be stored and relayed over space and time. Those processes of storage and transmission affect content; they create the possibility for content to appear in one place and not another.

One example of this from my work that I have been thinking about is the emergence in the 1960s and 1970s of radio (and then televisual) broadcasts of Quranic *tafsir* (exegesis). In northern Nigeria, during Ramadan it is traditional for eminent sheikhs to provide *tafsir* from their mosques in the evening after the fast has broken. Hundreds attend these lessons every night, where a *mai bita* reads a passage of the Quran and the sheikh explains its meaning and significance. It is a constitutive part of religious authority. In the 1960s, an important Salafi sheikh began to have his *tafsir* recorded and then broadcast over the radio.[48] As these broadcasts became hugely popular, his Sufi opponents agitated that, under the logic of balance, one of their leaders should have the same privilege. The state responded by alternating, so that one day the broadcast came from a Salafi sheikh, the next a Sufi, and so on. Upon its arrival, television added to this with its own broadcasts. Nowadays during Ramadan, alternating between television and radio, one can tune into a Salafi, a Tijani (Sufi), a Qadiri (Sufi), or an "independent" sheikh, depending on one's preference.

On one level this represents a relay of an established religious event, in that the broadcasters go to a mosque; the sheikhs do not go to a studio. They simply re-broadcast an event that existed long before radio and television, and the vast majority of Hausa Muslims see these broadcasts as extensions of a ritual activity made available to people who, because of social hierarchies and physical distance, could never gain access otherwise. The content of both the live event and its radio and televisual broadcast, by this logic, is seen as the same.

But, on the other hand, the act of mediation transforms that which it circulates. Radio and television were established by the British and inherited by the Nigerian state as public service technologies. The idea of balance presumes an equivalence between different ideas that should (ideally) receive equal consideration. By showing a Tijani sheikh on one channel and a Salafi one on another, the presumption is that these are aimed at a broad public which then chooses which one to listen to or watch. That in itself represents a transformation of traditional religious education—particularly the sheikh-disciple relation important in Sufism. There, the follower should be, as one sheikh explained it to me, "like a corpse at the hand of the man who washes it," in that one owes total devotion and loyalty to one's sheikh. This is the opposite of the idea of the subject who listens and chooses which argument he sees as superior. Where *tafsir* at one time emphasized the power and authority of the sheikh, by being relayed over radio and television the same content now addresses the agency of the listener/viewer who chooses which to listen to. Broadcast has taken a religious act and resignified it within the secular public sphere so that while the content is the same, its ramifications are quite different.

This raises the point Neil ends with about the transformative power of the "global clock" of the Internet. He argues that even as indigenous peoples in Brazil make use of technology for their own ends, they may end up being captured by it in ways that transform their own cultural frameworks. I am very interested in these processes and

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[48] I explore this event and its ramifications in "Islamic Renewal, Radio, and the Surface of Things," in Birgit Meyer ed., *Aesthetic Formations: Media, Religion, and the Senses* (New York, 2009), 117–136.

see them as an encounter where there are different forces at stake. In the case of the radio, for instance, the intentions and aims of the British colonialists who introduced the radio network played a large role in determining what that technology was. But as soon as broadcasts were available, northerners were tuning in to listen to Nasser in Egypt rather than the British broadcasts the system was built for. This is a case of Nigerians taking an existing system and diverting it for their own uses, but their ability to do so is limited by the technical capability of the means of relaying information.[49] Both British colonialists and Nigerian subjects have to contend with the material qualities of the radios themselves, which operate with a relative independence from either of their intentions.

Johns: Let me begin by saying that I've found the comments by Neil and Brian very interesting because they deal with something I've never really had to confront, namely the introduction by powerful outsiders of an information system that is already familiar to the outsiders but is new to the particular setting in question. I take the point that constructivist arguments about media cultures need to adapt in order to engage with the problems presented in such cases. I think that they can do that, however. And they can do it partly by thinking in the terms suggested in this third question.

  I think there are indeed cases when the message is the medium, and they can be very interesting for thinking through the kinds of issues we've been dealing with. What I take the phrase to mean (but I'm ashamed to say that I've never really felt confident that I know what McLuhan himself was getting at in the original version) is that sometimes media are consolidated or implanted in new regions because of the messages that their proponents want them to convey. That is, the message is the vehicle for the expansion, consolidation, or translation of the information system, rather than vice versa. The example that leaps to mind is only cross-cultural in a limited sense. It comes from Victorian Britain, at the time when steam printing was new. The publisher Charles Knight was a major advocate of industrialized printing, and he used it for a series of "improving" projects such as *The Penny Magazine* that were directed at a mass readership that hadn't really existed before. The idea was to channel mechanical and other modernizing forms of knowledge to the industrial working classes. Appended to an early issue of the magazine was a supplement that provided a detailed account of the printing and other processes involved in its own manufacture.[50] So the steam-printed magazine made its own steam printing into a principal subject of its own improving mission. That was entirely typical of Knight and his Society for the Diffusion of Useful Knowledge, whose publications often included laudatory publicity for the medium that produced them. Was the medium being boosted by the message, then, or the message by the medium? Undoubtedly both. I think it's not altogether rare to find this kind of recursive relationship between medium and message, especially in circumstances of rapid change. Missionaries introducing print to new cultures have often used similar strategies, I believe. At least, I remember coming across a report of such an enterprise once and suddenly being

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[49] The philosopher Michel Serres refers to this hijacking of information systems as parasitism; Serres, *The Parasite*, trans. Lawrence R. Schehr (Minneapolis, 2007).
[50] "The Commercial History of a Penny Magazine," http://english.cla.umn.edu/PM/CommHist.html.

struck by the idea that this kind of recursion, made necessary by cross-cultural or cross-temporal media movements, was where the notion of powerful, unitary media cultures came from.[51]

Then there is the issue of how esoteric knowledge and restrictions to information flow fare in contexts where "access" and "openness" are virtues. I've long found this an interesting issue. Certainly, in early modern Europe esotericism was paradoxically popular in the early generations of print, with "books of secrets" selling well and novel forms of open concealment (as it were) being tried out. A great example is a book by an alchemical thinker named Michael Maier, which included emblems, poems, and music intended to convey occult truths: the music was misprinted, by all accounts deliberately, in the conviction that the true adept would be able to correct the notes and produce powerful knowledge, whereas the novice or neophyte would be left in harmless ignorance.[52] A combination of typography and reading practices was used here so that openness itself—the book was published commercially—reinstated differential access.

More generally, I'd start to address this kind of issue from two observations. The first comes from Peter Galison's work on secrecy.[53] Galison makes a simple but, I think, vertigo-inducing discovery. Used as we are to the massive information warehouses of places like the British Library, the Library of Congress, and Google Books, we tend to think of the secret world as an esoteric backwater. However, it so happens that acts of classification—of making information secret to some specific degree—are counted in Washington and the raw numbers published annually. Based on this, Galison is able to show that one's assumption that most information is non-secret is simply wrong. The domain of secret information is far, far larger than that of open information stored in places like the Library of Congress. The gap is growing larger all the time, and the *rate* at which it is growing larger is growing larger all the time, too. It's not that the secret world is an appendage to the non-secret, but vice versa. And this in the age of the Internet and "open access"! Much of Galison's subsequent analysis is about the practical institutions that have arisen to gate-keep this burgeoning secret realm.

The other observation comes from a new book by Jo Guldi, *Roads to Power*.[54] The book is partly about the politics of participation and access to communications networks, and it points out empirically that for the modernizing side to win required, in this instance, the outside support of something like a state. It's a very ambivalent story, with no obvious heroes (although the villains are a bit clearer). One point is that a network that looks open, equalizing, modernizing, pacific, and rational to one part of society is likely to be socially corrosive, corrupting, and generative of endless conflicts for others. "Access," "openness," and "equality" only carry meanings when one asks "For whom?" and "On what terms?"

[51] I was looking at a manuscript at the American Antiquarian Society in Worcester, Mass.; I think it may have been William Jenks's ca. 1810 "Arguments for the Formation of a Printing Establishment in Western Asia," AAS Book Trades Collection, Box 2, Folder 4.

[52] For books of secrets, see William Eamon, *Science and the Secrets of Nature: Books of Secrets in Medieval and Early Modern Culture* (Princeton, N.J., 1996). The Maier example is cited in Adrian Johns, "The Physiology of Reading," in Marina Frasca-Spada and Nick Jardine, eds., *Books and the Sciences in History* (Cambridge, 2000), 291–314.

[53] Peter Galison, "Removing Knowledge," *Critical Inquiry* 31, no. 1 (Autumn 2004): 229–243.

[54] Jo Guldi, *Roads to Power: Britain Invents the Infrastructure State* (Cambridge, Mass., 2012).

What these indicate to me is that the practices of gatekeeping—those of keeping gates open as well as those of shutting them—need to be historicized, and historicized in a non-prejudicial way. Both flow and stasis are "achievements," as historians like to say. Out-and-out censorship is only one extreme on a spectrum of practical techniques that extend into the realms of rhetoric, design, machinery, and consumption. To go back to the early modern period, almost all regimes had some institutional system to edit, rechannel, or otherwise manipulate print, and not merely to suppress it. These systems were inseparable from the agencies that we associate with the positive agencies of communication and information themselves: those of publishing, distribution, and reading. A striking example is that of Sir Roger L'Estrange, the Restoration government's "Surveyor of the Press," whose policing/censorship operations were funded by sales of newspapers. That combination of "push" and "pull" hints at a huge historical topic which I think has barely been touched. But it's of central importance. For example, copyright—and subsequently intellectual property, the basic legal concept underpinning our information infrastructure—came about initially in order to replace the Restoration "censorship" system. The printing trade itself did not think that an orderly marketplace of information could survive without some such gatekeeping system.

Gitelman: Thank you, Brian and Adrian, for tackling this question first. I confess that as a participant in or partisan of the material turn you describe so lucidly, Brian, I've found myself a little resistant to thinking about "content" at all. The whole notion of content-and-container as separate or separable just seems so alien, even—or perhaps particularly—in textual studies, where I sometimes hang my hat. Of course, it's striking that while we've been busy with the material turn, the media industries have been so explicit about capitalizing "content" pure and simple, whether in the push to extend copyright or in merchandising across media platforms and into Happy Meals.

In doing media history, though, I guess I *have* sometimes encountered content driving technology. The recording styli of early phonographs, for instance, were designed in relation to the timber of women's voices. Jonathan Sterne's forthcoming book on the history of MP3 technology has a more interesting example, since he's at pains to show the ways that the MP3 standard relies upon perceptual coding and is thereby based on a particular model of hearing. When you listen to an MP3 file of a pop song, then, its content consists of that model of hearing even as much as it does the pop song, right?

On that question of the esoteric, Adrian's appeal to the marvelous Peter Galison piece on secrecy and the removal of knowledge makes me think that there must also be other, less sinister registers at which knowledge gets removed or obscured. Will Straw has a wonderful meditation on VCRs and the culture of video rentals, for instance, in which he evokes cinema as an accelerative cultural form.[55] The upshot is that before the widespread availability of video rentals, cinema was a more fleeting, more esoteric knowledge, because you could only ever see things when they ran in theaters, and repeat runs were relatively rare. Now we tend to think of video rentals

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[55] Will Straw, "Embedded Memories," in Charles R. Acland, ed., *Residual Media* (Minneapolis, 2007), 3–31.

as having inspired esoteric knowledge, too, among trivia hounds and within specialized fan groups, for instance. (I'm thinking of Lucas Hilderbrand's book on video here, too.)[56] All part of the way, as Straw writes, that new media "have consistently rendered the past more richly variegated and dense."[57]

Safier: Although there are many threads in our conversation thus far, one of the areas that I think relevant to a discussion of media and messages, like Lisa's example of the phonograph, is the manner in which societies have recorded spatial orientation over time—what we would refer to today as the geographical sciences, but which should be understood in its broadest sense as the way that cultures make sense of place and their surroundings. Maps are particularly important to think with, since their privileged status in our own culture tends to confer upon them a certain degree of authority that other forms of spatial communication—first-person narrative, reported speech, sketches and drawings—do not seem to have. Throughout human history and in distinct cultural settings, groups and individuals have used a staggering array of material objects—sticks, stones, pens, burins, magnets, as well as (more recently) GIS and computer pixels—to orient themselves and communicate that orientation to others seeking to find their way in the world—physically, metaphorically, cosmologically, or otherwise. From Polynesian stick charts, made primarily of wood and rope and thought to portray the location of islands as well as sea currents, to early modern European portolan charts, which emphasized navigators' knowledge of coasts and wind directions, individuals and groups have adapted certain kinds of technology and environmental understanding to the specific task of conceptualizing landscape, environment, and spatial processes. And, not surprisingly, the diversity of media—from paper maps to mental maps—throughout time and across cultures has been dynamic and impressive.

But the process of transforming spatial perceptions into communicable media has never been an entirely open and transparent process; nor has there ever been a universal language or generally agreed-upon symbolic system to portray forms of territorial understanding. Maps, as recent scholarship has forcefully shown, come in many shapes and sizes.[58] And yet, despite this, cartographic knowledge has been seen as a set of data that should be protected, often at tremendous cost. One of the best historical examples is the Padrón Real, a map kept carefully guarded at the Casa de Contratación in Seville in the sixteenth and seventeenth centuries and regularly updated on the basis of pilots' and navigators' reports from overseas. The cosmographers responsible for maintaining this map kept their American (and other) discoveries hidden from the view of other nations.[59] Here we have an informational system that was deliberately maintained off limits, but which could, if shared by navigators and bureaucrats of Spain's imperial competitors, be seen as providing

[56] Lucas Hilderbrand, *Inherent Vice: Bootleg Histories of Videotape and Copyright* (Durham, N.C., 2009).

[57] Straw, "Embedded Memories," 12.

[58] For an innovative selection of essays describing maps' multivalent functions and forms, see James R. Akerman and Robert W. Karrow, Jr., eds., *Maps: Finding Our Place in the World* (Chicago, 2007).

[59] On early Spanish cosmography, see María M. Portuondo, *Secret Science: Spanish Cosmography and the New World* (Chicago, 2009); and Alison Sandman, "Controlling Knowledge: Navigation, Cartography, and Secrecy in the Early Modern Spanish Atlantic," in James Delbourgo and Nicholas Dew, eds., *Science and Empire in the Atlantic World* (New York, 2008), 31–51.

crucial information and unfettered understanding for covetous neighbors throughout the early modern Atlantic world.

This brings us back to the question of translation, and the extent to which objects and media enable communication across cultural frontiers. The purportedly universal knowledge inherent in certain maps—and here we can remember Bruno Latour's assertion that maps functioned as "immutable mobiles"—was itself dependent on forms of tacit knowledge that may be more difficult to trace.[60] One of my favorite examples comes from the late-eighteenth-century Amazon, where a Portuguese naturalist making a set of statistical population maps casually encountered a Macushi Indian of the Rio Branco region who, of his own volition, grabbed a stick from inside the traveler's hut and began drawing a map on the floor: an ephemeral graphic representation of the confluence of several rivers. Later, after having presumably impressed his observer, the Macushi was given a pen and some paper to repeat in a portable format what he had drawn in the dirt, at which point he made a series of sharp angles to represent mountains and large and small circles to represent indigenous population centers in the region. Without skipping a beat, the naturalist took this map to the governor of the captaincy and showed it as well to the party's astronomer. We don't know if this particular representation entered into the European cartographic record, but we can certainly imagine that such a scene would not have been entirely uncommon. A few questions spring to mind: Did the Macushi learn the symbolic system of circles and chevrons from his European interlocutors? Or did the use of a stick (and later a pen) predispose the indigenous cartographer to make the marks in the way that he did? And how often did the Portuguese depend upon this kind of local knowledge to construct their small-scale territorial representations? These are opaque zones in the history of knowledge circulation, but without tracing the outlines of these processes, broad and fuzzy as they may be, we are likely missing a good portion of the action, even if we cannot always color in between the lines to our own satisfaction.

Technologies of registration clearly have a role to play here: these are scenes that were recorded with ink and paper, mediated by forms of communication that were themselves often inscribed on parchment, on rocks, in landscapes, or as artifacts that traveled and were exchanged between cultures. There is always a question of scale when discussing the causes and effects of circulation, but any fine-grained analysis seems to return us incessantly to what is happening on a local level. As Marshall Sahlins has written elsewhere, "the specific effects of the global-material forces depend on the various ways they are mediated in local cultural schemes."[61] This observation shifts our emphasis back again toward the highly particular uses of media, in ways that a given technology's "creators" might never have imagined or even accepted had they ever been given a choice.

Hecht and Edwards: The question was about the degree to which "information" or "knowledge" in any period may be esoteric, privileged, deliberately illegible, or

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[60] See Bruno Latour, *Science in Action: How to Follow Scientists and Engineers through Society* (Cambridge, Mass., 1987), chap. 6.

[61] Marshall Sahlins, "Cosmologies of Capitalism: The Trans-Pacific Sector of 'the World System,'" in Nicholas B. Dirks, Geoff Eley, and Sherry B. Ortner, eds., *Culture/Power/History: A Reader in Contemporary Social Theory* (Princeton, N.J., 1994), 412–456.

otherwise removed from general understanding or even perception. The fascinating responses have respectively laid greater emphasis either on "information," in the sense of content, messages, Galison's universe of classified documents, etc., or on "knowledge," for example, Neil's points about the Padrón Real and the Macushi Indian mapmaker's techniques of representation. We'd like to dig a bit deeper into the question of knowledge.

When Gabrielle posed a question about content during the discussion of the second question, she didn't intend to invoke either "the medium is the message" or its converse. Indeed, she confesses (and perhaps she should blush as she does this?) that she wasn't thinking about McLuhan at all—but keep in mind that she is not a media studies person, which among other things means that media in and of themselves are not her object of study. It has frankly never occurred to her to separate content and container, analytically speaking. So let's go at this another way.

Robert Proctor's useful term "agnotology" refers to the deliberate or structural production of ignorance. Many things are deliberately kept secret, yes. But some knowledge is never produced at all—not because no one's thought of it, but rather because either (a) forces work strategically against producing it (as in the case of tobacco companies, for example), or (b) knowledge production infrastructures are not set up to generate that type of knowledge (as Michelle Murphy has argued with respect to the emergence of "sick building syndrome").[62]

For us, then, the more important framework is that of *knowledge* infrastructures. These include media and messages, but they also include the production and consumption ends of the knowledge process. A crucial historical question (as others have already noted in their answers) is always how knowledge production (as well as transmission) shapes and is shaped by power relations. For example, apartheid-era mining companies did not require black South African miners to wear film badges to detect radiation exposure, partly because they "knew" that African migrant miners didn't spend enough time underground to contract occupational diseases from mining. Nor did most miners there—white or black—know enough about radiation risks to insist on being monitored. There are now estimates that some 10,000 miners were exposed to elevated levels of radiation in South African uranium-gold mines between the 1950s and the 1990s, exposures that substantially increased their risk of cancer and other diseases. But we'll never know.

More broadly, few or no data were collected on mining-related diseases (of any kind) among black Africans *after* they stopped working and returned home. This matters for knowledge production (as well as for the miners themselves, of course) because many such diseases take decades to manifest. The effects of the knowledge production process that existed in mines throughout the twentieth century continue into the present; we know considerably less about rates and profiles of these diseases among black southern African miners than among white miners, who were moni-

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[62] Robert N. Proctor and Londa Schiebinger, *Agnotology: The Making and Unmaking of Ignorance* (Stanford, Calif., 2008); Murphy, *Sick Building Syndrome*. See also Allan M. Brandt, *The Cigarette Century: The Rise, Fall, and Deadly Persistence of the Product That Defined America* (New York, 2007); Gerald Markowitz and David Rosner, *Deceit and Denial: The Deadly Politics of Industrial Pollution* (Berkeley, Calif., 2002); Robert N. Proctor, *Cancer Wars: How Politics Shapes What We Know and Don't Know about Cancer* (New York, 1995); David Rosner and Gerald Markowitz, *Deadly Dust: Silicosis and the Politics of Occupational Disease in Twentieth-Century America* (Princeton, N.J., 1991).

tored more carefully but also differently exposed, because they typically worked in different parts of the mines. Here the secrecy—or perhaps a more pertinent term would be invisibility—was racist, of course, but in a structural and systemic way. It stemmed from (1) the difficulty of disease *detection* when miners were sent back home to areas that don't have substantial medical infrastructures, and (2) the difficulty of having even detected diseases count as "occupational diseases" to be potentially compensated by the mining industry in the absence of *information* infrastructures for transmitting disease data across national borders, or even within those borders.[63]

Whereas in some cases one might say that knowledge becomes information when it becomes an object of consensus and gets banalized as "common knowledge," in this case we see the obverse: failure to transmit information (about diagnoses) translates into a structural inability (or failure) to produce knowledge about occupational disease.

Gabonese uranium miners, to take another example, had less access to "information" about radiation and radon hazards than did miners and citizens elsewhere. An insufficient information framework, however, supposes that knowledge about such hazards is stable and can be abstracted from its context (and that it can be easily and unproblematically transferred from one location to another). But as Gabrielle argues in her forthcoming book, knowledge about radiation hazards in mines was deeply, fundamentally contextual—it had to be remade in each place, through a complex process of gathering data and getting different kinds of knowledge infrastructures to speak to each other in commensurable terms.[64]

A more banal and much more widespread form of structural secrecy—or perhaps structural confusion is a better term—emanates from the deformation and reformation of language as groups create specialized cultures. We see this everywhere in the sciences, which frequently apply special meanings to ordinary words in ways that make it difficult for outsiders to understand. A case in point is the word "uncertainty." It has many meanings for scientists, but the baseline use of the term refers to a quantifiable degree of expected or measured error in the use of instruments. Discussions of this type of uncertainty are everywhere in science, where they have a reasonably well-constrained sense. But when climate scientists begin talking to reporters, they tend to lead with the "uncertainties" inherent in both climate data and climate models. For most of us, though, "uncertain" means "unsure"; it is a disqualifying term that connotes a lack of knowledge. And the misunderstandings pile up from there. Such instances can easily be enumerated ad nauseam. For example, Americans associate the word "aerosol" with spray cans; this leads to an ongoing confusion between ozone depletion (caused by chemicals now banned from aerosol cans) and climate change (which has little to do with ozone depletion), and

[63] Scholarship on occupational disease in South African mines includes Randall M. Packard, *White Plague, Black Labor: Tuberculosis and the Political Economy of Health and Disease in South Africa* (Berkeley, Calif., 1989); Jock McCulloch, *Asbestos Blues: Labour, Capital, Physicians and the State in South Africa* (Bloomington, Ind., 2002); Elaine N. Katz, *The White Death: Silicosis on the Witwatersrand Gold Mines, 1886–1910* (Johannesburg, 1994). Julie Livingston offers a brilliant analysis of what happened to debilitated miners when they returned home to Botswana in *Debility and the Moral Imagination in Botswana* (Bloomington, Ind., 2005).

[64] Gabrielle Hecht, *Being Nuclear: Africans and the Global Uranium Trade* (Cambridge, Mass., forthcoming 2012).

even greater confusion about the very important role of aerosols (airborne particles) in climate change.[65] This is a major reason why achieving public understanding of climate science is not merely a matter of providing "information," and why frameworks that abstract "content" from knowledge production and consumption often miss the point.[66]

AHR Editor: Gabrielle and Paul's response contains a comment that, I suspect, will provoke many to consider a distinction that usually escapes our awareness—that between "information" and "knowledge." Or at least it implies a level of conceptual rigor that common usage of these words doesn't usually convey. They note that "knowledge becomes information when it becomes an object of consensus," suggesting as well that a "failure to transmit information" can thwart the production of "knowledge." This distinction might help us get a grip on a question that I believe must be raised in this discussion, for it clearly troubles many in this so-called information age. In a sense, it addresses the other slope of the previous question, which had to do with secrecy, privileged information, esoteric knowledge, and the like. And it has, alas, become a cliché of this "age." But as Ann Blair has recently reminded us, it has been a vexing concern at least since the Renaissance.[67] This is the question of TMI—too much information. How should we think about this without panicked proclamations of the utterly novel, unprecedented, or even apocalyptic nature of the contemporary state of affairs? Might the distinction between "information" and "knowledge" be helpful in conceptually addressing this question? Might thinking more about "infrastructures" also be of use in this context? Historians are not immune to what has become a very pressing concern, both in their intellectual and professional lives and in the general culture they inhabit. The fear, I think, is not only that there is too much information, piling up at an alarming rate, but that "it" is also unstable, ephemeral, and thus simply worth less and less—that, in a sense, we are producing a surfeit of information but very little knowledge. Can you help us think about this question with more historical awareness than is normally present in our discussions?

Gitelman: "Information" as it gets thrown around today arrives by dint of cybernetics, of math and signal processing, though the present, abstract meaning of the term is a bit older than cybernetics. As Geoff Nunberg explains, knowledge and culture may be holistic, but "information is essentially corpuscular, like sand or succotash"; it's "a uniform and morselized substance."[68] This usage and the conceptual field it helps to mark emerged during the nineteenth century sometime, when common parlance began to confuse the function of reading (to be informed) with the content of what is read: information.[69] The concept has a certain sprawl to it, too, suggesting, for instance, that phenomena can be "reduced" to data, that data can be

[65] Richard C. J. Somerville and Susan Joy Hassol, "Communicating the Science of Climate Change," *Physics Today* 64, no. 10 (2011): 48–53.

[66] Edwards, *A Vast Machine*.

[67] Ann M. Blair, *Too Much to Know: Managing Scholarly Information before the Modern Age* (New Haven, Conn., 2010).

[68] Geoffrey Nunberg, "Farewell to the Information Age," in Nunberg, ed., *The Future of the Book* (Berkeley, Calif., 1996), 117, 116.

[69] Ibid., 113.

"raw," and—today's correlative—that "everything" can and will be digital or digitized.

Knowledge, by contrast, is situated, and Paul, along with Geoffrey C. Bowker and Susan Leigh Star and others, has profitably described the situatedness of knowledge in terms of infrastructures. All to say that today's sense of "too much" and the sense of too much experienced by others in the past can indeed be distinguished, at least since the entity there is too much *of* has continued to change according to the materials and practices of knowledge production. Ann Blair's account of the finding aids and organizational schemes in early modern reference books offers some great examples, since the "too much" organized by elaborate branching diagrams by Conrad Gesner, for instance, and the "too much" organized by Montaigne's logic of the self-assayed look like different versions of "too much" to me, even if as a shorthand we anachronistically call them too much information.

Johns: I think Lisa is absolutely right to point to the changes that have taken place in "information," such that what we are complaining about having too much of is not what Renaissance scholars complained about having too much of. They are different, yet the fact that earlier generations had some comparable experience means that our own is not altogether unprecedented. As always, it's important to historicize feelings of exceptionalism. After all, having too much input in some sense is just part of being sentient—it isn't as though people in cultures without writing don't endure a constant influx of experiences. It's the texture of the issue in any particular setting that matters, and that is historical precisely in the way in which it seems beyond our control.

My view is that we should focus on the practical ways in which different cultures address that class of experiences. Writing itself may have originated as one such way, if prehistoric tablets that seem designed to list numbers of animals and the like are any guide.[70] The consequential point is that any such techniques, technologies, or conventions are likely to guide their users positively as well as negatively. If they filter out the insignificant and allow us to focus on the significant, or if they sort the undifferentiated traces of reality into files, or if they permit us to "speed-read," they also commonly channel us toward certain perceptions as well as away from others. Ann Blair's book is largely about these techniques in the Renaissance, and it shows that they led to the generation of certain kinds of knowledge.[71] We can—arguably, to be responsible, we must—apply the same kind of insight in the present, and to ourselves. My own sense is that the historical profession is in something like a holding pattern right now, waiting to settle on its proper practices with respect to massive online libraries like Google's. Those practices are not predefined or self-selecting, especially given the well-known problems with Google's system in particular. (You can't trust searches that rely on its metadata in any straightforward way.) They will take time to define and refine. We ought to be more explicitly reflective about the historicity of that process.

The reason for this is obvious. There is a risk that people come to see the world

[70] Eleanor Robson, "The Clay Tablet Book in Sumer, Assyria, and Babylonia," in Simon Eliot and Jonathan Rose, eds., *A Companion to the History of the Book* (Malden, Mass., 2007), 67–83.
[71] Blair, *Too Much to Know*.

that is made visible through our counterparts to Renaissance scholarly techniques as corresponding to the world of evidence itself. It doesn't. And it certainly can't be assumed to correspond even further, to the world "out there." Access methods for universal libraries, now as in 1500, are not neutral windows. Research has shown pretty clearly that search engines are, as Donald Mackenzie says in regard to financial models, precisely *engines*.[72] In the sciences, for example, it seems well established now that they can accelerate the formation of consensus on research issues at the possible expense of missing less predictable or orthodox possibilities.[73] The benefit is real; so is the cost. The way to proceed is not to eschew them but to find how to control them creatively, for which an understanding of how such reading practices develop over time is likely to be vital.

To reiterate, it is not that older methods of access (bibliographies, card catalogues, "browsing," etc.) were undistorting, in contradistinction to ours. All methods have their inherent biases. But previous generations of readers learned how to cope with and maybe counteract their methods' tilts. They were acculturated into practices of cross-checking by using other methods and consulting different kinds of evidence. The juxtaposition of manuscript and printed sources, for example—and then of engravings, paintings, and so on—in early modern studies was something that historians were supposed to acquire as a second nature, partly because early moderns themselves did. The parliamentary clerk John Rushworth, for example, began his *Collections*—a history of the civil wars of the 1640s and 1650s—with explicit reflections on the need to "con-credit" sources in such ways, and Milton's *Areopagitica* was partly about the moral virtues of working hard at such tasks.[74] Some such discipline of juxtaposition will need to be invented and applied now, at the different levels necessitated by digital collections. But the apparent universality of online materials, coupled with our extraordinary dependence on one filtering channel (Google again)—and the occasionally strident insistence of primary and secondary educators, as well as university administrations, that we move wholesale to digital learning practices—predisposes the current generation not to notice the need for such skills. We are the only ones who are going to insist on the necessity of their developing them, and we should. ("Milton! Thou shouldst be living . . . ")

It may be worth adding a couple of subsidiary points. One is that massive online libraries change what counts as a discovery, in history as in other fields. A generation or two ago, work in science studies created a historicized understanding of discoveries as processes, involving among other things the retrospective stipulation of critical moments.[75] I suspect that we will need another spell of work to account for what a discovery is in this new data environment. The second is that if we are interested in diachronic change rather than synchronic mentalities—and either is a respectable historical interest—then traditionally the people we have focused on in the early

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[72] Donald MacKenzie, *An Engine, Not a Camera: How Financial Models Shape Markets* (Cambridge, Mass., 2006).

[73] James Evans, "Electronic Journals and the Narrowing of Science and Scholarship," *Science* 321 (2008): 395–399.

[74] John Rushworth, *Historical Collections of Private Passages of State, Weighty Matters in Law, Remarkable Proceedings in Five Parliaments*, 8 vols. (London, 1659–1701), 1: sig. b2r; other citations in Johns, *The Nature of the Book*, 171–174.

[75] Much of this followed from Thomas S. Kuhn's *The Structure of Scientific Revolutions* (Chicago, 1962).

modern period have *not* been those who devoted themselves to becoming adepts at the period's methods for amassing information. There are a few exceptions: Gesner and Leibniz, and perhaps Kepler. But by and large we have looked rather to Copernicus, Galileo, Descartes, Bacon, Shakespeare, Hobbes, Pascal, Newton, et al. These were people for whom the techniques of data management were familiar to some extent, but who confined them to the status of tools, to be combined with other tools. They were not exactly proselytes for a new, data-centered information culture. Newton, for example, was by no means the information isolate that has often been portrayed, but on the other hand he was no Polyhistor, either.[76] I don't mean to revive an old-fashioned canon, but it is nevertheless striking to me that this seems to be the case. I suspect something similar may be at hand now. The people who produce the most significant work in the age of Google Books will be those who fully exploit such resources but at the same time know how not to let the technologies dictate the questions they ask.

Safier: A topic I have tried to stay focused on throughout our conversation, which seemed at times central and at times peripheral to the flow of the discussion, is the importance of defining knowledge through its social dimensions, something that the latest responses of Gabrielle, Paul, and Adrian—as well as this week's question—also imply. One way we can differentiate between information and knowledge—if indeed such a distinction can be generically made, for once again it seems to me that these are not transhistorical and transcultural categories—lies precisely in the manner in which what we call "information" is parsed, channeled, codified, and employed by individual groups, often defined by social rather than intellectual criteria. Knowledge, whether at the scale of local entities or at that of the global scientific community, gains status as something significant when it is agreed upon and deployed, even while it is subsequently subject to modification and refinement according to constantly changing criteria.

This understanding of the social nature of knowledge was for me placed into sharp relief through my own recent experience on a journey that took place during the time we have been conducting this conversation. For ten days, I participated in a "floating campus" along the Amazon River, along with a group of professors, students, filmmakers, and activists from throughout Brazil. The project, sponsored by three Brazilian universities, was conceived as a way to bring scholars and students into contact with local communities in the Brazilian state of Pará. One of the projects I was able to observe personally in Santarém, a medium-sized city located at the confluence of the Amazon and Tapajós rivers, was the Coletivo Puraqué, a program for the expansion of digital culture and sustainable technological development in Amazonia that was heavily influenced by the 1970s liberation theology of Leonardo Boff.[77] For me, it was an uncanny instantiation of a previous thread in our conversation, and a case where the idea of information infrastructures seemed particularly apposite. The concept behind the project, at its outset, was to use information tech-

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[76] Simon Schaffer, *The Information Order of Isaac Newton's "Principia Mathematica"* (Uppsala, 2008), http://www.idehist.uu.se/vethist/pdf/schaffer.pdf.

[77] The Coletivo Puraqué website is at http://puraque.org.br/. For a study of the life and works of Leonardo Boff, see Horst Goldstein, *Leonardo Boff: Zwischen Poesie und Politik* (Mainz, 1994).

nology as a catalyst for constructing social communities and enabling groups without access to computers and the Internet—from underprivileged urban youth to distant native communities—to become end users, programmers, web designers, and hackers. My two local guides, Jader and Tarcísio, explained to me that in the early stages of their project, they used technology to mediate between rival gangs who were battling each other on the streets of Santarém. Later, the Puraqué project was able to install information kiosks and run workshops in urban, rural, and indigenous communities—which it continues to do today. Not only did the access these communities have to information increase exponentially, but, as Tarcísio explained to me, they were better able to band together and oppose large-scale political projects as a collective, something that would have been nearly impossible before the introduction of information technology into their communities.

This is obviously not a historical example, but it reminds me that access to information is far from merely an academic question. After reading Adrian's latest response, and thinking about the distinction between information and knowledge, and what might constitute "too much" of either, I began to wonder what the transplantation of new technologies into these communities might mean in practical terms for their residents, and whether thinking historically about the present might somehow be useful to projects like the Coletivo Puraqué. In that part of the world, communication tools have traditionally been in the hands of those in power, those who used textual and graphic mechanisms to describe, to catalogue, and ultimately to control the resources of the region. This was as true in Europeans' early exploration of the Amazon basin as it is for the massive hydroelectric and mining projects that are gobbling up ever-larger swaths of the forest today. The introduction of steamships, railroads, and telegraphs in Amazonia during the nineteenth and early twentieth centuries almost inevitably served the interests of a narrow, outsider population, usually to exploit the knowledge and labor of local groups, and the arrival of the Internet may function similarly. But as individuals in an ever-widening community share the latest of these communication tools, and as they attempt to put these resources to practical uses, they too will ponder what this relatively new technology actually enables them to achieve. True, they may not have been "acculturated" to have a critical distance from the tools they employ, but at the very least they are enfranchised as members of a broader discussion. What I saw in my brief visit to Santarém were groups of children and teenagers with a genuine thirst for more contact, more communication, and more information, not less. This led me to think that our own sense of "too much information" may in fact be highly culturally specific, and that in asking these questions, we have already become, as Adrian feared we might, focused on the methods to amass information rather than using this technology as liberating tools to achieve tangible goals.

The most challenging aspect of thinking historically about information and knowledge involves making the leap between seemingly incompatible knowledge regimes, the utility, logic, and organization of which are established independently—and often opaquely—by individual groups or communities in different linguistic, spatial, and temporal settings. The gulf between *ribeirinho* (river-dwelling) hackers and North American university professors may be similarly vast. We as scholars may be concerned about the present, technology-driven transformations in how knowl-

edge is organized and delivered because we perceive them as an affront to those methods by which we ourselves were educated and enfranchised, much like those Renaissance scholars who were sensing dramatic changes in the ways that texts and images came to be presented in their own day. Eighteenth-century authors felt similarly. In the "Prospectus" to the *Encyclopédie, ou Dictionnaire raisonné*, published in 1751, Denis Diderot and Jean Le Rond d'Alembert explained that the "Republic of Letters was inundated [with treatises]" and that scholars had to contend with a meteoric increase in the amount of material available to them, a veritable "sea of objects" which they confronted as they sought to reorganize the world textually in their printed compendium of universal knowledge.[78] We too may feel overwhelmed by the "sea of information" that arrives on our PDAs and laptops today, but we are rightly thrilled when we have more or less immediate access to materials—such as the digitized pages of the *Encyclopédie*, thanks to the University of Chicago's ARTFL project—that would have taken hours or days of careful research (and photocopying!) in well-stocked university libraries to access otherwise. What is more, as digital scholarly projects such as those run by Dan Edelstein and Paula Findlen at Stanford have shown, these tools can confirm in powerful, visual ways hypotheses for which we once lacked crucial evidence.[79] So as we lament the overabundance of information with which we are accosted daily, we should recall that every culture and each generation confronts the challenges of its own changing knowledge landscape. Many philosophers and writers from the early modern period who were dealing with "information overload" were also engaged in addressing their age's distinctive social problems. Perhaps the questions we pose today need to be defined even more sharply and with greater social awareness than before, inspired by the example of the Coletivo Puraqué. Otherwise, like those frustrated figures from the Renaissance, we may spend our time paradoxically bemoaning the overwhelming amounts of information we are now capable of accessing, without wielding this new technology to build something lasting or useful with it.

Johns: People probably know this already, but just in case: those liberation theology projects a generation ago included Ivan Illich's bid to circulate audio cassette libraries, to which indigenous villagers were supposed to add by recording their own contributions. The idea was to foster a creative, "bottom-up" media environment as opposed to the "top-down" system of television, which required expensive, centralized studios and the like, and which turned publics into passive consumers. I believe it ended up influencing those in Palo Alto who wanted to create democratic information networks and domestic computers, and hence played into the formation of our own digital world. So the connection is actually fairly direct. At least, that's my inference from books like John Markoff's *What the Dormouse Said*.[80]

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[78] "Prospectus," in Denis Diderot and Jean Le Rond d'Alembert, eds., *Encyclopédie, ou Dictionnaire raisonné des sciences, des arts et des métiers* (Paris, 1751–1772), http://encyclopedie.uchicago.edu/node/174.

[79] The "Mapping the Republic of Letters" project can be found at http://republicofletters.stanford.edu.

[80] John Markoff, *What the Dormouse Said: How the 60s Counterculture Shaped the Personal Computer Industry* (New York, 2005).

Larkin: I would like to echo Lisa and Adrian that it is important to trace not just the histories of technologies but the history of the concepts we use to speak about them. Both "information" and "knowledge" are terms whose meanings have transformed over time along with intellectual and political shifts (a process Raymond Williams famously analyzed for terms such as "culture" and "society").[81] Nowadays information is seen as part of a scale of complexity where data are the raw phenomena and information is the processing of those phenomena into higher-order meanings. But just as often we use the two interchangeably. As Lisa points out, these definitions bear the imprint of information theory, which introduced a radical shift in meaning to the idea of information, one that is leveling and potentially devastating to older humanist hierarchies of meaning (encoded in concepts such as "knowledge"). Information theory shifted focus away from semantics and toward processes of transmission. The mathematician Warren Weaver famously wrote, "*information* must not be confused with meaning. In fact, two messages, one of which is heavily loaded with meaning and the other of which is pure nonsense, can be exactly equivalent . . . as regards information."[82] "Information" thus allows us to make commensurate things that in other situations would be deeply incommensurate. The Bible and reality TV shows, Shakespeare and an instruction manual are all considered as effectively the same under its mantle. "Knowledge" has a different history, one enmeshed in hierarchies of quality, ideas of self-cultivation, and notions of civilization that the term "information" elides. For the cultural critic Matthew Arnold, for example, knowledge was tied to his concept of culture, part of the epitome of human achievement: "Great men of culture are those who have had a passion for diffusing, for making prevail . . . the best knowledge, the best ideas of their time."[83] Knowledge, for Arnold, is part of an internal self-cultivation, a *bildung*, that can only be possible if one distinguishes between qualities of knowledge in a way that the term "information" denies. If information is processed data, then knowledge is information combined at a higher order of meaning (for Arnold culture would be a higher level still). This is a different concept of knowledge from that used by Gabrielle and Paul, but it is precisely because these terms have differing lineages of meaning that we need to keep their historical mutability in mind.

I also support the Editor's and Adrian's desire to de-exceptionalize the idea that our age is the only one inundated with information overload, but I doubt that the distinction between information and knowledge would be helpful in conceptually addressing these problems. That is because these terms are themselves artifacts of the social changes that produce information overload and do not stand analytically outside of this process offering a purchase from which to comment on it. One clear parallel to our era is the turn from the nineteenth century and the concern with the overload of the human sensorium brought about by urban modernity. Simmel's parsing of the urban arena as a site of constant nervous stimulation and information overload, Freud's concept of the stimulus shield (which he argued protected the

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[81] Raymond Williams, *Keywords: A Vocabulary of Culture and Society* (London, 1976). Lisa cites Geoffrey Nunberg, who provides one history of the concept "information": Nunberg, "Farewell to the Information Age."

[82] Claude E. Shannon and Warren Weaver, *The Mathematical Theory of Communication* (Urbana, Ill., 1998), 8.

[83] Matthew Arnold, *Culture and Anarchy*, ed. Samuel Lipman (New Haven, Conn., 1994), 49.

mind from being flooded with stimulus), and Benjamin's idea of "shock" as a feature of modern life all address this reality.[84] Jonathan Crary has argued that this is the period when "attention" emerged as a philosophical, medical, and social problem precisely because urban citizens were threatened with derangement brought about by new technologies of mental stimulation (among other phenomena).[85] These technologies and the urban arena itself threatened to overwhelm the stable, contemplative individual of the nineteenth century, introducing instead a nervous, hyperstimulated, distracted modern self. What links these different thinkers is that the concern for sensory overload and analysis of the anxieties it provokes ultimately is revelatory of the erosion of one sort of social subject (and the world that produced her) and the emergence of another. It is a process of transition between states that generates tension, and it would be interesting to trace back earlier moments of anxiety over information inundation to see if similar transitions are at stake.

The issue of "too much information," as the Editor defines it, particularly the sense that information is "unstable, ephemeral," and piling up at an alarming rate, also raises the question of archives. The move from letters to e-mail and from texts to websites changes the relations between fixity and ephemerality—always a concern of historians—raising methodological and interpretive questions. Archives are both proliferating and disappearing at the same time. If information today is now worth "less and less," this may be because we have yet to develop the techniques and interpretive tools that are demanded by the innovations in communication that make new demands on the discipline of history.

Finally, I would like to return to Neil's interesting post. In my field (anthropology), the use of communication technologies by indigenous activists has received a lot of excellent scholarly attention and is clearly an issue of importance.[86] But this returns us to an earlier question we discussed about the ability of humans to "use" technologies versus the danger that the reverse may be true. The introduction of digital technologies as a means of providing new communication tools that aid human agency is a well-worn tradition that—in colonial arenas, at least—stands in a line of other such projects from the introduction of print, radio, video, and computers. Each introduction is premised on the idea that these are neutral technologies that can be put to use locally to empower those individuals and communities who use them. But there are forms of control inherent in technologies as well as capabilities for liberation. Technologies impose standardized conditions both in technical features and in the social competence required to use them. Standardization is frequently a form of power. To me, the idea that technology empowers individuals is an ideology introduced along with the technology as well as being an outcome of its use. This is not to deny Neil's point, as it is indeed important to recognize the contexts

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[84] Georg Simmel, "The Metropolis and Mental Life," in Simmel, *The Sociology of Georg Simmel*, trans. and ed. Kurt H. Wolff (New York, 1950), 409–424; Sigmund Freud, *Beyond the Pleasure Principle* (New York, 1990); Walter Benjamin, "On Some Motifs in Baudelaire," in Hannah Arendt, ed., *Illuminations: Essays and Reflections* (New York, 1968), 155–200.

[85] Jonathan Crary, *Suspensions of Perception: Attention, Spectacle, and Modern Culture* (Cambridge, Mass., 2001). See also Stephen Kern, "Speed," in Kern, *The Culture of Time and Space, 1880–1918* (1983; repr., Cambridge, Mass., 2003), 109–130.

[86] This research is now huge, but important starting places remain the works of Faye Ginsburg and Terence Turner. Introductions to both can be found in Faye D. Ginsburg, Lila Abu-Lughod, and Brian Larkin, eds., *Media Worlds: Anthropology on New Terrain* (Berkeley, Calif., 2002).

of use, but in doing so we shouldn't lose sight of other features. The reified idea of "print culture" that Adrian is suspicious of is a paradigmatic example of the belief that modern communication technologies will liberate human agency. This is an internal feature of the ideological complex of print culture, but it is an argument made in turn for the telegraph, video cameras, and computers.

Hecht and Edwards: We certainly agree that "information" and "knowledge" are categories with social and intellectual histories and changing meanings, and that scholars can learn by being attentive to these. We also agree that claims to novelty are themselves political claims with consequences in the world. But since we've already covered these themes in previous responses, here we riff on some other ideas.

As others have noted, the problem of TMI—too much information—has ancient roots. The problem of finding a desired item of information in a large pile of similar items—from tax records to scrolls to books—has plagued librarians and bureaucrats for millennia. Labeling documents, classifying them, and composing catalogues to enable easier searching are all ancient practices. The library classification systems of today date to the middle of the nineteenth century, when Melvil Dewey and others created complex schemes for classifying knowledge. The fact that such schemes resorted, for the first time, to abstract alphanumeric codes rather than more meaningful memory systems based on words and images can be read as an indicator of the problem's increasing scale.

One issue that's come up repeatedly since at least the beginning of the twentieth century regards the question of the "natural size" of meaningful information units. We are speaking here not of Claude Shannon's famous unit, the bit (short for "binary digit"), which was a way of measuring information as an aggregate of binary choices; Shannon's innovation was to eliminate the consideration of meaning from the analysis of a channel's capacity to transmit it. Instead, we are talking about something more like a "fact" or a "statement," the kind of thing you are looking for when you want to know the population of Tucson or the exact coloration of the oriole. Such a unit is clearly much smaller than a book or a journal article.

The once-forgotten Mundaneum of Paul Otlet and Henri la Fontaine, established in Belgium in 1910, eventually dissected thousands of documents into more than 12 million index cards linking individual facts and statements to publications, all indexed under an elaborate decimal classification scheme. Vannevar Bush's much more famous Memex (short for "memory index"), frequently cited as a precursor to the World Wide Web, was a Rube Goldberg fantasy machine built from microfilm cameras, readers, projection screens, and typing devices. It was supposed to enable a scientist to create a personal library that would simultaneously record his [*sic*] associations among ideas, articles, and images. J. C. R. Licklider, among the most important figures in 1960s computing, spoke of his frustrations with too-large information units in Libraries of the Future (1965). Like Otlet and Bush before him, he dreamed of reducing knowledge to "schemata" whose intricate linkages could all be mapped within a computer, enabling researchers to simply pose a question and go directly to the answer, bypassing the annoying and hard-to-index collections of publications on which all previous libraries were based. These visions are all rou-

tinely cited today as origins of hypertext and its modern apotheosis, the World Wide Web.[87]

Though it is easy to be swept up in a Whig-history version of events, the truth is that these visions of knowledge as molecular structures of atomic units long pre-date the computer age; the Mundaneum rendered them real in a universe of paper and print.

The modern manifestation of these ideas is, of course, Google. Search and ye shall find—but find what? The problem is familiar to us all: though we find factoids by the billions, socially meaningful knowledge can still elude us. Googling away, anyone can readily create the incoherent collage of factoids and falsoids all too familiar as an undergraduate "research" paper. At the same time, expertise—deep knowledge based not only on a collection of facts and rules for combining them, but on understanding and experience—can be devalued or overthrown. The old adage held that "you have a right to your own opinion, but you do not have a right to your own facts." The new adage seems to be that "you have a right to your own opinion *and* to your own facts." Which leads us to branch off in two directions:

Direction 1: Google and its techno-kin often float in an ideological aura of democracy and liberation, as Brian notes.. But of course it's not just that technologies of all kinds have capacities for both control and liberation (and Brian is absolutely right to point to standardization as a form of power—a recent collection of essays edited by Martha Lampland and the late Susan Leigh Star explores this very issue).[88] It's also that the ranking of Googled information is far from random. All sorts of entities have found ways to game the Google search engine, like playing the stock market, to jack up their PageRank (to cite only the crudest expression of power). As Adrian notes, a similar point could be made about all sorts of information engines. Economists, for example, like to describe prices as the result of ultra-complex social information processing. Armed with this description, they then use prices to produce knowledge about "the economy." This use of price-as-information-system, in turn, enables claims that economic action is *and should remain* separable from politics—a deeply political claim that rarely gets recognized as such in public discourse (never mind by the experts and policymakers themselves).[89]

Direction 2: The right wing in the USA has come to embrace the revised version of the adage ("You have a right to your own opinion *and* to your own facts") and applies it to subjects including climate change, evolution, Iraqi weapons of mass destruction, and much, much more. Right-wing politicians and pundits have embraced the idea that knowledge is socially produced and acquires meaning only in

[87] Jay David Bolter, *Writing Space: The Computer, Hypertext, and the History of Writing* (Hillsdale, N.J., 1991); Alex Wright, *Glut: Mastering Information through the Ages* (Washington, D.C., 2007); James N. Nyce and Paul Kahn, *From Memex to Hypertext: Vannevar Bush and the Mind's Machine* (Boston, 1991); Vannevar Bush, "As We May Think," *Atlantic Monthly*, July 1945, http://www.theatlantic.com/magazine/archive/1945/07/as-we-may-think/3881/; J. C. R. Licklider, *Libraries of the Future* (Cambridge, Mass., 1965).

[88] Martha Lampland and Susan Leigh Star, *Standards and Their Stories: How Quantifying, Classifying, and Formalizing Practices Shape Everyday Life* (Ithaca, N.Y., 2009).

[89] MacKenzie, *An Engine, Not a Camera*; Timothy Mitchell, *Rule of Experts: Egypt, Techno-Politics, Modernity* (Berkeley, Calif., 2002); Michel Callon, ed., *The Laws of the Markets* (Malden, Mass., 1998); Michel Callon, Yuval Millo, and Fabian Muniesa, eds., *Market Devices* (Malden, Mass., 2007); Hecht, *Being Nuclear*, chap. 2.

social context—a notion originally developed by left-leaning scholars in the course of their political, cultural, and epistemological critique—and used it to produce an impasse. (Talk about the revenge of unintended consequences!) They redescribe fringe science as pre-paradigmatic, invariably holding up Galileo as the universal representative of the brave lone scientist resisting the ignorant majority. (Never mind that Galileo resisted not so much fellow scientists as certain doctrines of the Catholic church.)[90] In the U.S., at least, the impasse is aggravated by the excessive application of journalism's ideology of the "balanced" story, where "balance" seems to mean giving both factoids and falsoids equal treatment.[91]

All of which places those of us interested in the (social, cultural, political, etc.) situatedness of knowledge in a quandary. We (the wider scholarly community) are still struggling to find a solution to this quandary that allows us to be true to our best epistemological intuitions. This is why, as we (the authors) said at the very beginning of this *AHR* Conversation, we feel it's no longer enough to point to the social meanings of knowledge, to the historical construction of categories, to the ways in which actors make claims about novelty or rupture. Doing all that remains useful work, but it can no longer be our stopping point. Living as we must in the politics of the present, we cannot be content with historicizing the production of truth.

AHR Editor: This has certainly been a wide-ranging conversation. Even so, there are undoubtedly many other topics and issues we might have discussed. Looking back over the exchanges, I am struck by the insistence on the materiality and specificity of the means of the circulation of information, as well as the care taken to avoid dramatic assertions that demark contemporary trends and developments as fundamentally distinct from those of the past. Curiously, we never touched upon an issue related to our topic that, I would imagine, resonates locally for each of us, or indeed with anyone concerned about the future of libraries and book and journal publishing. What will happen to these modes of distributing knowledge and information as we move deeper into the digitization process? I'm sure past editors of the *AHR* were burdened with many problems and uncertainties, but I doubt whether they ever had to contemplate that the very format or mode of the journal might not survive the technological transformations of their day.

[90] Edwards, *A Vast Machine*, chap. 15; Naomi Oreskes and Erik M. Conway, *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming* (New York, 2010).

[91] Maxwell T. Boykoff and Jules M. Boykoff, "Balance as Bias: Global Warming and the US Prestige Press," *Global Environmental Change* 14, no. 2 (2004): 125–136.

Paul N. Edwards is Professor of Information and History at the University of Michigan. His research focuses on the history, politics, and culture of information technologies and infrastructures. His book *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming* (MIT Press, 2010), a history of the global meteorological information infrastructure, was named a "Best Book of 2010" by *The Economist* and received the 2011 Computer History Museum Prize of the Society for the History of Technology. He has also written *The Closed World: Computers and the Politics of Discourse in Cold War America* (MIT Press, 1996), as well as other books and numerous articles. Edwards has been a Carnegie Scholar and a Guggenheim Fellow. His current research concerns the social dynamics of monitoring, modeling, and memory in large scientific cyberinfrastructures, as well as further work on the history of meteorology as a computational science.

Lisa Gitelman is Associate Professor in the Department of English and the Department of Media, Culture, and Communication at New York University. She is the author of two books, *Scripts, Grooves, and Writing Machines: Representing Technology in the Edison Era* (Stanford University Press, 1999) and *Always Already New: Media, History, and the Data of Culture* (MIT Press, 2006). Since earning her doctorate from Columbia University in English and comparative literature, she has taught at Rutgers University, Catholic University, and Harvard University, as well as NYU. She is a former editor of the Thomas A. Edison Papers, a documentary editing project based at Rutgers.

Gabrielle Hecht is Professor of History at the University of Michigan. Her work focuses on how technologies shape, limit, embody, and enact power. She recently edited *Entangled Geographies: Empire and Technopolitics in the Global Cold War* (MIT Press, 2011). Hecht's first book, *The Radiance of France: Nuclear Power and National Identity after World War II* (MIT Press, 1998, 2009), received the AHA's Henry Baxter Adams Prize and the Edelstein Prize from the Society for the History of Technology. Her new monograph, *Being Nuclear: Africans and the Global Uranium Trade* (MIT Press and Wits University Press, 2012), remakes understandings of both the nuclear age and modern Africa by looking at the colonial, transnational, and postcolonial histories of uranium production in five African countries. Hecht was an ACLS Burkhardt Fellow, and her research has received support from the National Endowment for the Humanities and the National Science Foundation.

   Hecht and Edwards have published jointly on technopolitics in the transregional Cold War and in apartheid South Africa. They plan to co-author a book on the entwined pasts, presents, and futures of nuclear power and climate change.

Adrian Johns was educated at Cambridge University, where he got a Ph.D. in the history and philosophy of science in 1992. He has taught at the University of Kent, the California Institute of Technology, and the University of California, San Diego, and is currently Allan Grant Maclear Professor in the Department of History at the University of Chicago. He is the author of *The Nature of the Book: Print and Knowledge in the Making* (University of Chicago Press, 1998), *Piracy: The Intellectual Property Wars from Gutenberg to Gates* (University of Chicago Press, 2009), and *Death of a Pirate: British Radio and the Making of the Information Age* (W. W. Norton & Company, 2010). He is currently working on the industry that has arisen in the modern age to defend the information economy against hackers, pirates, counterfeiters, and the like.

Brian Larkin is Associate Professor at Barnard College, Columbia University. He is the author of *Signal and Noise: Media, Infrastructure, and Urban Culture in Nigeria* (Duke University Press, 2008). The book traces the introduction of media technologies into the Muslim north of Nigeria and examines the interaction between technologies, Islam, and political rule. His current project examines the rise of Islamic movements in Nigeria and the formative role that media play in encoding and recoding religious practice. He sits on the board of the Society for Cultural Anthropology and is a member of the *Social Text* collective.

Neil Safier is Associate Professor of History at the University of British Columbia, Vancouver, and author of *Measuring the New World: Enlightenment Science and South America* (University of Chicago Press, 2008; paperback forthcoming in 2012), which was awarded the 2009 Gilbert Chinard Prize. He received his Ph.D. from Johns Hopkins University in 2004 and has subsequently held teaching and research positions at the University of Michigan and the University of Pennsylvania. An early modernist by training, he has published widely on Spanish and Portuguese imperial histories, exploration and science during the Enlightenment, cultures of reading and print, and environmental history. During the current academic year, he is Dibner Fellow in the History of Science at the Henry E. Huntington Library in San Marino, California, where he is working on two projects: a multidisciplinary history of Amazonia, using archaeological, anthropological, and deep historical perspectives; and the history of Portuguese scientific expeditions in the Atlantic and Luso-African worlds.