The unevenness of knowledge distribution in modern society has profound social and political implications. Through more careful attention to contextualization, translation, and self-assessment of specialized knowledge such as science, audiences might be assisted to acquire the type of knowledge which is necessary for them to become not just potentially informed but actually knowledgeable on such subjects.

Communication Lag

PETER CAWS
The George Washington University

When I joined its advisory board in 1990, this journal was called *Knowledge: Creation, Diffusion, Utilization.* This title seemed to cover a sufficiently comprehensive territory, enough at any rate to keep a philosopher happy. However, from the point of view of the philosophical theory of knowledge, known in the trade as epistemology, it left a few crucial aspects of knowledge out and made a couple of assumptions that called for defense. Is all knowledge created? Isn't some of it discovered? How do we recognize it for what it is once created or discovered? Is it all useful? "Diffusion" was about the only unproblematic element in the subtitle, so it seemed right that, under the guise of "communication," that was the aspect of knowledge that survived the journal's metamorphosis. At the same time, the concept of knowledge got sharpened, with the new title, into its special form as science. So then we knew where we were, much better than before: the focus was to be on how scientific knowledge gets around, from one scientist to another, from scientists to nonscientists, from the lab to the journal to the media, from the Nobel prize winners to the postdocs and from the postdocs to the

Author's Note: Address correspondence to Dr. Peter Caws, University Professor, The George Washington University, 2130 H St., NW, Gelman Library Suite 714-UV; phone: 202-994-8685; fax: 202-994-8683; e-mail: pcaws@gwu.edu.

Science Communication, Vol. 20 No. 1, September 1998 14-21

also go to Tricia Mastrobuono, whose work as *Science Communication*'s editorial assistant has consistently demonstrated not only boundless good humor but unflagging professionalism and the highest ethical standards.

MARCEL C. LaFOLLETTE has been Editor of Science Communication (formerly Knowledge: Creation, Diffusion, Utilization*) since 1990. She is the author of* Making Science Our Own: Public Images of Science, *1910-1955 (University of Chicago Press, 1990) and* Stealing into Print: Fraud, Plagiarism and Misconduct in Scientific Publishing *(University of California Press, 1992). Dr. LaFollette is currently writing about the policies and politics of late twentieth-century science communication.*

sixth-graders—with all the possibilities for oversimplification, obfuscation, misunderstanding, grandstanding, alarm, celebration, and even fraud, that these channels and processes of communication lend themselves to.

Now the journal reaches a new turning point with the end of Marcel LaFollette's firm and genial editorship, and to mark the event the advisers are invited to become contributors for a change. What has been happening to science communication over the last eight years? What are the trends, problems, portents that we see in our respective fields? The thing that strikes me most forcefully as I look at the distribution of scientific knowledge in the world is how *uneven* it is. In a way it follows the same pattern as wealth: there are haves and have-nots, there is north and there is south, and Robert Merton's "Matthew Principle" operates ("for unto every one that hath shall be given, and he shall have abundance: but from him that hath not shall be taken away even that which he hath," Matthew 25:29) (Merton 1968). In other words, just as in the economic case, the epistemically rich are getting richer and the epistemically poor are getting poorer.

However, there are some striking and significant differences between the distribution of goods and the distribution of knowledge. One of them is that in the knowledge case, the poor very often don't know they are poor. Not knowing you don't know is an old philosophical target—it was what Socrates went for with the Athenian statesmen and poets and craftsmen, all of whom thought they were pretty clever but none of whom could stand up to his ironic questioning. The situation 2400 years later is similar but with a few twists. Our contemporaries genuinely do have access to a lot of what the Athenians didn't have much of, namely, information. Access is the operative word here: the apparatus for information retrieval, in some parts of the world at least, is in place, and if people only knew what to ask for and what to do with it, the flow of knowledge would be more efficacious than it is. But access is not acquisition—and information is not knowledge, except in a very limited sense. This last distinction is not terribly well understood, so that a lot of people think themselves epistemically rich just because they have access to a lot of information, even though they often do not know which are the important bits or what to do with them.

What is the difference between information and knowledge? I define knowledge as an ability that individuals have to say trustworthy things and give good reasons for thinking them trustworthy. That's not perfect—it's possible to construct clever counterexamples—but it corresponds to what we usually mean by knowledge and is probably about as good as we're going to get. An ability, not a practice—you could know things and not let on, or you could say what you knew without defending its claim to be knowledge. To show that what you say is trustworthy, you have to know that it is, from which

follows an old theorem in epistemology to the effect that if I know that X, then I know that I know that X. Four kinds of knowledge seem to me to be worth distinguishing from one another; I call them direct, indirect, paradigmatic, and fiduciary. Very briefly:

- *Direct knowledge* is knowledge I can produce on demand—it's in my head, or immediately to hand.
- *Indirect knowledge* is knowledge I know how to acquire—I know where to look, or whom to ask, and when I've looked or asked I can incorporate what I've learned, at least temporarily, into my stock of direct knowledge.
- *Paradigmatic knowledge* is the direct knowledge I need to activate indirect knowledge (for example, there's no point in looking up the GNP if I don't know what those letters stand for or how the concept of gross national product is defined).
- *Fiduciary knowledge* is knowledge of the reliability of my sources of indirect knowledge.

Note that knowledge is an ability to *say*, not merely to repeat. I can receive and even pass on information, but if I don't make it my own, connect it to the rest of what I know, bring my critical judgment and creative understanding to bear on it, I won't be able to say it in my own voice or show anyone else why he or she should trust it.

We come by our knowledge through a process of what I call instruction—"in-struction," the structuring of the inner. We acquire it as mental structure, namely, as relations that come into play when our minds are challenged by problems or questions. Instruction, again, comes in different forms:

- *Genetic* or *epigenetic instruction* is originally hardwired, or gets that way developmentally, by competition among neural circuits, for example.
- *Experiential instruction* happens in our encounters with the world, when we notice and remember things, events, and processes.
- *Cultural instruction* comes through our encounters with other people. We absorb whole prestructured chunks of what may become knowledge from parents, priests, professors, pundits. For most of us, this accounts for the bulk of what we come to know.

But none of this will really become knowledge unless we do the work that is necessary to make it our own. That is why to genetic, experiential, and cultural instruction I add a fourth category:

- *Autonomic instruction* is the structuring of the contents of our minds that we carry out by cogitation, reflection, silent questioning, working through, specu-

It's not surprising, in this context, if we wind up talking about education. For it seems to me that there are three meanings, or versions, of what in my title I call "communication lag." There's a more or less benign version, which brings up another difference between the distribution of knowledge and the distribution of goods: in the knowledge case, there's no common market, as it were, so that technical knowledge in one specialty doesn't translate directly into technical knowledge in another. Specialists in different fields experience what we might call a mutual lag—they may have to spend some time explaining to one another not only the results of their work but also its significance (I'll come back to this). Then there's a more obvious and more serious version, whose implications are less scholarly than social and political: the unevenness of knowledge distribution means that less privileged individuals and communities lag behind more privileged ones, an issue which certainly needs to be tackled.

But solving this problem won't help much if nothing is done about the less obvious version I've been discussing: that very often—far too often—the state or capacity of the knower on the receiving end of the communication lags behind the demands of the content of the communication. In the case of the mutual lag between specialties, this doesn't matter very much and is remediable, but in the case of science communication in a political context, it can matter quite a lot and fixing it will take more work. It's not just harried legislators who need education in this matter, along with the time to absorb and practice it (note that I don't mean to suggest here that they are all dummies—some of them are brilliant and well informed), but also voters, bureaucrats, teachers. Jefferson's recipe for a working democracy was to "educate and inform the people"; and in a letter to George Wythe on 13 August 1786, he wrote: "I think by far the most important bill in our code is that for the diffusion of knowledge among the people. No other sure foundation can be devised, for the reservation of freedom and happiness" (Ford 1892, 268).

The challenge of the coming years will be to make sure that education keeps up with information, so that information has a chance to be grounded in knowledge. It's all too easy to throw the term "educational" around and imagine, therefore, that the problem is being addressed, but often what passes for education (for example, a lot of so-called educational programming on television) is really only information under another name, and sensationalized information at that. It must be obvious from what I've said that the process of education can't be reduced to sound bites, or to marvels and mysteries. On the other hand, to adapt a familiar cliché, we don't have to turn everyone into a rocket scientist either; the habit of responsible critical reflection, and the attitude that acknowledges ignorance and refrains from position-taking until that ignorance is addressed, can be acquired by any

> lation, the floating of new ideas, and the discarding of old ones. Some of this work can be done in company with other people struggling with the same issues, but a lot of it is and inevitably must be carried out alone and in private.

Now it's an accident, but a neat accident, that the fourth kind of knowledge and the fourth kind of instruction are at once the most important and the most neglected. Most of us don't carry around a whole lot of direct knowledge, and most of us don't learn that much (comparatively speaking) from experience. Fiduciary knowledge: we rely on other people, and we ought to be more concerned than we usually are (although *Science Communication* and its editor have been doing their bit to raise consciousness on this point) about their reliability. Autonomic instruction: we take in a huge amount of information every day, and we ought to spend more time than we usually do on processing it, critically and imaginatively. Being aware of, and being able to do, these things doesn't come with information, it comes only with education, and a very special kind of education at that. It also takes time. It once occurred to me (I'd been asked to speak at a congressional breakfast on behalf of the humanities) to inquire how much time the average member of Congress spent each week in reflective thought. A survey had been done, so the information was available: the answer was seventeen minutes (whatever that might correspond to in practice—a good question about statistical information generally). Later I mentioned this in conversation with one of the senators from my state: "What seventeen minutes?" he asked, looking around wildly—"I want my seventeen minutes!" If information, as I've been claiming, doesn't become knowledge unless it's reflectively processed, then the legislative branch is in deep trouble. But of course we already knew that.

What sort of education does it take to move from being potentially informed to being actually knowledgeable? A large question, but with some obvious answers: for a start, education into an awareness of just the difference between knowledge and information that I've been discussing, then education into habits of criticism and reflection, and so on. A philosophical education, one might say—it's no accident that Plato thought philosophy and government were closely connected, although he has been much misunderstood (he didn't mean that anyone who claimed to be a philosopher should become a king, but he did mean that no king who lacked what he called "the spirit and power of philosophy" was likely to be very good at being king). Of course, not all knowledgeable people get involved in government (it would be good if more of them did), but part of Plato's point was that all of us are involved at least in self-government, and the same considerations apply.

thoughtful person capable of listening and waiting. But sometimes it's hard to listen unless the volume is turned down, and sometimes it's hard to wait when the rhythm of communication to which we've become accustomed is as rapid and staccato as it often tends to be.

When there's a lag between leader and follower, the situation can be corrected by one of two obvious strategies: the follower can speed up, or the leader can slow down. In the present case, we might use a bit of both. I've been speaking of the education of the laggards, but there might be something to be said for the self-discipline of their informants. Francis Bacon, who in his time had as bold and advanced a vision of the possibilities of science and its communication as anyone before or since, speaks somewhere of hanging weights on the understanding rather than giving it wings, and there may be a hint in that metaphor for our own time. Here are some weights we might hang on communication to make it more responsive to the conditions I've been discussing:

- Contextualization, by specialists for specialists. This would address the mutual-lag problem. It would mean that every communication would include a brief assessment of its situation in relation to the field of science generally, a kind of locator paragraph that would enable other researchers to see its relation to their own work.
- Translation, by which I don't just mean an abstract in a foreign language (those are sometimes very useful, though it might be interesting to try some nonmainstream languages for a change)—rather, a conscious attempt to think through, and say, what the results being discussed might mean for cultures remote from the writer's own.
- Self-assessment, or self-critique, in the form perhaps of a challenge to the reader to do the work of absorption and working-through that I've been advocating as a necessary concomitant of the mere reception of information. What else do you need to know to make full use of what we're telling you? How do you know you can trust our credentials? What are the implications of our topic for decisions you may be called upon to make in your personal, professional, or political life?

By this metaphorical weighing-down I don't mean to suggest total encumbrance—but rather a habitual supplementation of what gets communicated by some acknowledgment of its setting and its systemic interconnections. What would I say, under these three headings, of this very communication, the occasional essay I now bring to a close? Some of the contextualization I've already done, in acknowledging its occasion in my relation to the journal in which it appears; it must be obvious that it comes out of a philosophical preoccupation with the nature and distribution of knowledge and that it's

metadisciplinary in relation to the disciplines whose research forms the object of most scientific communication. I didn't do any research in writing it, it "all came out of my head," as a colleague once said, somewhat disparagingly I thought, about one of my books. The thing is that I thought about it quite a lot, and one of the things it stresses is precisely the importance of that activity: what comes out of the head isn't just what went into it; indeed, the most important part of the whole process of knowledge acquisition is probably what I've called autonomic instruction. I'm reminded of a story from a few years back about a research laboratory where the administration decided to tighten things up and sent around a questionnaire about what people did all day; in one of the branches, the scientists agreed to fill in every blank, 8:30-9, 9-9:30, and so on throughout the working day, with the single word "THINKING," which helped to show up the futility of the enterprise.

If I were to attempt a translation of what I've said into the idiom of another culture, I would raise the question of the benefits of communications technology, and of imported science, in the absence of a local educational base. Not that I would want to argue against the provision of aid by way of information or the donation of cellular equipment or satellite dishes or whatever—but I would want to argue that aid in such forms is a mixed blessing if not accompanied by support for indigenous development in literacy and critical competence. This sounds as if it would be advice addressed to some third world economy, but something like it would be equally pertinent for urban and inner-city school systems or even the personnel divisions of major corporations, where the dangers of information technology outrunning insight and intellectual competence are as great as anywhere.

Finally, the assessment and the challenge. How should anyone—why should anyone—integrate what I've said into his or her operational knowledge structure? What are my qualifications for pontificating like this? I don't know what the editor will say in the section on contributors, but this is a test of fiduciary knowledge. And yet perhaps in such a case the qualifications of the author are less important than the quality of the argument. Thomas Hobbes ([1651] 1968, 82) offered the following observation by way of justification for his rather sweeping conclusions about human nature: "whosoever looketh into himself, and considereth what he doth, when he does think, opine, reason, hope, feare, &c, and upon what grounds; he shall thereby read and know, what are the thoughts, and passions of all other men, upon the like occasions." Method in the human sciences differs from method in the natural sciences among other things in this, that on each occasion of argument, instead of referring to a common and physical external object, each participant has to conjure up an individual and mental internal object. I tell you what my object

is like and invite you to examine your object, and you do the same for me, with a view to seeing whether, if we manage to duplicate one another's work, we may not come to see our objects in the same way.

So my invitation to you is to see knowledge, and instruction, and the structure of communication, in the ways I've suggested in the foregoing pages. Ideally I would get feedback, which might lead me to modify my own position—not radically, I might hope, given the narcissism of authors, but perhaps constructively. For the progress of knowledge, in a formula I've come to use often in my teaching, can be assured only through *mutual instruction under mutual criticism*. That is surely an enterprise to which this journal has always been committed.

References

Ford, P. L., ed. 1892. *Jefferson's writings*. Vol. 4. New York: G. P. Putnams.
Hobbes, T. [1651] 1968. *Leviathan*. Reprint. Harmondsworth: Pelican Books.
Merton, R. 1968. The Matthew Effect in science. *Science* 159:56-63.

PETER CAWS is University Professor of Philosophy at The George Washington University. He has been a Fellow of the American Association for the Advancement of Science since 1968 and is the author of seven books, including Yorick's World: Science and the Knowing Subject (University of California Press, 1993) and Structuralism: A Philosophy for the Human Sciences *(Humanities Press, 1997 [first edition 1988]). He is a member of the Editorial Advisory Board for* Science Communication.

Science communicators face two perennial problems: first, how can one maintain the integrity of science communications in the face of forces which may tend to degrade them, and second, how can science communications be made more useful for the individuals who are most in need of their messages? The author offers some practical advice for addressing these questions in context.

The Message in the Bottle and the Genie in the Lamp

Information Integrity and Individualization in Science Communication

LOIS-ELLIN DATTA
Datta Analysis

"*What do you see* as the most interesting question for scholars in your field in the next decade or so?" Ah, so many possible questions, so little time! For starters, however, one could hardly do better than re-reading "Editorial: Changing Our Name, Adding New Voices, Renewing Responsibility" (LaFollette 1994). In a beautifully organized vision of our field, LaFollette identified issues of (1) communication among researchers or within technical communities; (2) politics and policies; (3) ethics, equity, and economics; and (4) speaking out—news and entertainment media. In each section, the topics were so juicy, so salient, so rich, one wanted, in 1994, all of the above—and this one still does. Happily, her editorial proved both an inspiration and a guide. For example, it was particularly splendid to read Foreman's (1995) "Editorial Commentary—Witchcraft Science in the Cinema of Epidemics,"

Author's Note: Address correspondence to Dr. Lois-Ellin Datta, Datta Analysis, P.O. Box 383768, Waikaloa, HI 96738; phone: 808-883-8670; fax: 808-883-8670; e-mail: 74434.1122@compuserve.com.

Science Communication, Vol. 20 No. 1, September 1998 22-27