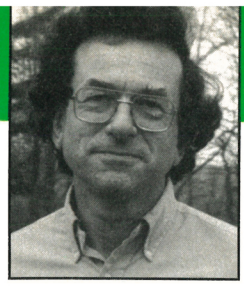
REFERENCE FRAME



WHAT'S WRONG IN COMPUTOPIA?

N. David Mermin

Professor Mozart burst into my office, waving the January 1992 issue of PHYSICS TODAY. "What are you doing here, W. A.?" I greeted him in surprise. "I thought you were abroad fund-raising for the SSC!"

"Just got back," he gasped, having apparently run up all five flights of stairs. "Castro says he'll provide all the cigars if we can persuade Bush to lift the sugar quota. Just sent Bromley a memo. Don't see how Congress can drag its feet any longer—especially when we remind them that accelerator physics gave us ride-on lawn mowers, sliced bread and the compact disk. But what about this response to your call last May for the abolition of journals in favor of electronic bulletin boards? Ten letters to the editor—all but two hostile? As a pundit, you've got it made!"

"Thank you," I replied sourly, "but the fact is I received even more letters that were wildly enthusiastic—by far the biggest response I've ever had."

"Don't tell me," he said, lighting up an enormous Havana. "All the favorable correspondence came by e-mail. No copies to PHYSICS TODAY. Shun the print media. Matter of principle."

"You've got it," I confirmed, suppressing a gasp myself. "My supporters are all children of the network. I doubt they even use the telephone anymore, except as ancillary to a modem. They want me to lead the way into the shining electronic future, writing software, designing hardware, lobbying professional societies, organizing boycotts, raising funds. . . ."

"Leave the fund-raising to me," he ordered through the smoke. "Your immediate problem is to answer your critics. How could you have expected to attack the refereeing process and come out unscathed? Don't you realize most people can't write an acceptable laundry list without peer review? Without referees we'd soon be promulgating inchoate blather. Can you imagine what *Hamlet* must have looked like the first time Shakespeare submitted it? Why, somebody once told me that *Othello* is what *Titus Andronicus* turned into after half a dozen exchanges. And you want to abolish refereeing!"

"Never mind how peer review operates under the current system," I interrupted. "What none of the critics have noticed is how much *better* it will work in Computopia."

"No doubt you're thinking," he murmured through the fog, eyes half closed, "of a parallel bulletin board of criticisms and errata."

"Precisely. Those genuinely interested in any paper—namely people who, unlike today's referees, spontaneously choose to read it—would have the opportunity to post laudatory or critical comments for the benefit of subsequent readers; the author, of course, could post a reply. The system would make available upon request the comments currently on file for each document."

"Every paper its own seminar talk!" Mozart burbled enthusiastically.

"Not quite," I pointed out. "Only those interesting enough to elicit a response. Can you imagine it—every paper of note collecting a constellation of signed commentaries from interested experts, available to all? What could be more enlivening! But what really surprised me was that nobody on either side of the issue seemed interested in the problem that led to my proposal in the first place."

"You mean the undemocratic monopolization of cutting-edge science by self-selected cliques through the proliferation of preprints as the primary publication procedure?" he asked, smiling with approval at the train of perfect little smoke rings that emerged from his preponderance of p's.

"Precisely," I coughed. "Journals or no journals, nobody is going to stop the circulation of unrefereed preprints. Most fields of physics have been exchanging their most important communications through preprints for well over a decade. Posting such documents on publicly accessible bulletin boards is hardly a utopian vision—it's a moral imperative. Furthermore, it works. The string theory and two-dimensional gravity people have been doing it for some time now—almost a thousand of them, worldwide. Nobody in the field sends out paper preprints anymore. Everything is fully automated—the system runs itself. Anybody anywhere can subscribe by sending in a single e-mail message. You get a daily list of new titles and abstracts, and can call up the complete text of any paper that might interest you in a matter of minutes. Papers are available for about a year and the whole thing occupies about 10% of the hard disk of one workstation in the office of one physicist at Los Alamos, operating in the background with a negligible drain on cpu time. There are no frivolous submissions and no practical jokes, just a large number of serious people exchanging ideas."

"String theorists not utopian?" he twinkled through the fog. "You've got to be pulling my leg."

"I know it's hard to believe," I said, "but this could well end up as their greatest contribution to science. They have seen the short-term future and converted their vision into a practical scheme for propagating their thoughts about the physics we may be using in the ultralong-term future. It's totally democratic: Everybody can be as up to date as the leaders of the field, without having to get onto anybody's preprint lists. Indeed, those in faraway places who were on the lists now benefit from the elimination of the old boat-mail de-

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lays in delivery. Everybody is better off. Why, even Glashow uses it!"

"Completely up to date on the physics of the 520th century," Mozart mused. His devotion to the SSC has led to an uncharacteristic intolerance of investigations that probe beyond the TeV range. "Considering when the relevant experiments are likely to be done, falling a century or two behind in the literature would hardly seem to be a handicap."

"You miss the point, W. A. It's a great intellectual adventure. Before the bulletin board opened up the field, you had to know the right people to get into the game. Now everybody can play."

"All well and good for a dedicated bunch of fanatics," he snarled through the haze, "but what happens when you try to extend that to a serious field like superconductivity, where you might end up with ten thousand subscribers?"

"You've been off fund-raising too long," I chided him. "Suppose every single subscriber also submits four papers a year, each 50 kilobytes long—twice the length of a *Physical Review* letter. That's 2 gigabytes a year. Why, even laptops these days can handle a tenth of a gigabyte. Do you really believe that existing technology can't give us a scheme that is capacious, inexpensive, easily accessible, capable of dealing with figures, and secure against accidents or deliberate sabotage? The files could readily be made available to libraries in a variety of inexpensive permanent storage devices at regular intervals for archival purposes, at a minute fraction of the cost of acquiring the same information on printed pages, and a minuscule fraction of the cost in floor space.

"But even if it strained us to manage it today," I pressed on, "if you consider where we are now and where we were a mere ten years ago, can you seriously doubt that in another ten years such technological problems as might currently stand in the way will have completely evaporated? One doesn't often have the chance to contemplate utopia a mere ten years down the road; if we want to be ready we'd better act now. Let's face it, the real objections to such a scheme aren't technological."

He looked at me with uncharacteristic admiration. "You're right, technological objections are entirely beside the point. If the scheme can't be shown to be inherently objectionable under ideal technological conditions, then it's inevitable." And as I leaped unsuccessfully to stop him, he ground out his cigar on a loose issue of *Physical Review Letters*. "The real trouble is lack of closure. When your paper appears in a journal, that's it. Your thoughts on the subject at that moment are frozen into the archives. Awareness of this sharpens the attention. It enforces a level of self-criticism, thoroughness and just plain careful proofreading that would simply not be elicited if you could repeatedly ship communications off to the bulletin board at a moment's notice. That's what you're giving up. It's not worth it." He brushed the sparks onto my rug.

"But it's a sociological fact that this simply hasn't happened in the existing schemes," I protested, frantically stamping out the glowing embers. "And there are powerful reasons why it won't happen. Science may once have consisted of discovering the truth and making it available to others, but today there's another problem almost as difficult: getting anybody to pay attention. When mountains of new work appear each month, most of it vanishes unnoticed. People on the bulletin board who acquired a reputation for repeated resubmissions of trivial revisions of earlier manuscripts would rapidly lose any audience they might once have had. They would cause nobody any further trouble, and the disk space wasted with their unread offerings would be vastly less valuable than the space they currently waste in the libraries, playing exactly the same game with conference proceedings. Since everybody could easily keep track of the number of people who requested copies of their papers, perpetrators of trivial resubmissions would quickly learn that nobody was paying any attention."

"That's right," said Mozart. "Give everybody a list of the names of all the readers of their papers, so they can go around harassing them or making paranoid accusations of plagiarism."

"The question of whether to preserve the anonymity of requesters is precisely the kind of interesting and important issue people should be discussing today, in the decade before Computopia sets in, rather than wasting their time declaring its impracticality."

"Of course," said Mozart, firing up, to my horror, an even bigger Havana, "your scheme is death to browsing. There's simply no way for a computer to simulate the experience of cuddling back in a comfortable chair and taking a leisurely literary stroll through a pile of promising periodicals in search of something entertaining but completely unanticipated." Three tiny smoke rings punctuated this thought.

"True," I admitted sadly. "The abolition of the library card catalog has already deprived us of a similar pleasure. All progress has its price."

"But possibilities do come to mind," Mozart offered cheerily. "Browsing is now necessarily an entirely random business, since it's humanly impossible to sample more than a minute fraction of the literature. One could easily build into the bulletin board a browsing capability that would present the determined browser with a dozen titles, randomly selected from a prespecified set of areas, defined as broadly or narrowly as required. You could even request a collection of randomly selected single pages from pages within specified browsing parameters. Nothing would be missing but the easy chair."

"But the easy chair is important," I insisted. "So is the feel of the paper, the smell of the ink, the crackle of the glue, the rustle of the pages, and the pungency of the mildew. A humane Computopia will have to maintain a small number of browsing periodicals."

"Peer reviewed?" he shot back.

"Of course," I conceded. "But since a primary criterion for acceptance in a browsing magazine would be readability, as soon as the task of refereeing verged on the disagreeable that in itself would be *prima facie* grounds for rejecting the piece. 'This paper should not be published because I find it tiresome' would be an entirely satisfactory report, and no great burden would be imposed on the refereeing community."

Mozart rose from his chair, wreathed in blue-white vapor. "Our colleague Schubert maintains that the real problem is human vanity. He says the present system hasn't died because we still believe that there is glory to be had in getting our words onto the printed page. Hard to understand, given the evidence that most printed pages languish unexamined, but maybe it's enough for the author alone to see the finished product—a sort of papyro-narcissism. Perhaps," he added, as he and the fumes drifted out my door and I dashed, wheezing, to the window and threw it open, "we could furnish such people with dummy journals where their papers were embedded in randomly selected collections of writings of great distinction. We could sell these volumes to such authors at a profit." The door swung shut behind him, but I could just discern his final muffled thought as he rambled off down the corridor: "Send the proceeds straight to Waxahachie. Pay for all the ashtrays." ■