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The Future of the Information Industry*

Also see Introduction on p.400, Essays, Vol:3

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I've just returned from a long trip abroad which I interrupted to get here in time to accept this award. ISI® 's Communications Director called me in Irkutsk to tell me about the award and that I was expected to talk about the future of the information industry. I had to disappoint some friends in Bangkok and Singapore, but I'm pleased to be here.

The trip itself reminded me of two old sayings. The first is that it is easier to be recognized as a "prophet" in a foreign land than in your own home town. Another version says there is more "profit" to be made in foreign lands.

Speaking of profit reminds me of a publisher who recently married a manager of an information company. Many members of the IIA and the AAP (Association of American Publishers) attended the wedding. At the proper point the minister asked if anybody had any objections to the marriage. There was the usual silence. Finally, one guy waved his hand and said, "I don't care if they get married, but would somebody like to hear about *my* information company?" Now, I'm not going to tell you about my information company. You've heard about it before. Naturally I think that our products, for those who need them, are superior.

Instead, let me tell you what I think is in store for the information industry. One can always speculate about the future. If you are wrong, who will remember? If you are right, you can always remind the historians how astute you were.

Most of my career has been devoted to "scientific" information. However, I prefer to think of the German word *Wissenschaft* or the Russian word *nauk*. Those equivalents to the word *science* are comparable to the English word *knowledge*. Neither ISI nor the IIA is limited to the area of *scientific* information, but the information industry received its early impetus in this area. That ISI is changing is indicated by the fact that we are now entering the arts and humanities. For the IIA, I foresee a rapid broadening of coverage. In particular, the information needs of the consumer will be developed and exploited in a variety of ways. The

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Viewdata system, which I will discuss later, is but one example of that. This is not to say that scientific information will not continue to be a major factor in the industry. But the largest untapped opportunities lie in the consumer area.

As for science itself, I believe the basic instrument of communication is the scientific paper. I don't think anything will replace it for at least a decade. What's more, scientists will continue to publish their papers in printed journals.

Since the trend toward collaborative research is accelerating, especially in areas like particle physics, the number of research team or "groupie" papers can be expected to increase. This has happened in the last decade in the People's Republic of China. As groups of collaborators become larger and more unwieldy, perhaps there will be more authors like the famous mathematician Bourbaki. Nicolas Bourbaki, one of the most cited authors in the mathematics literature, is the pseudonym for a group of French mathematicians. However, such group identification carries its own price in anonymity for the individual scientist.

Still, the scientific process is a very personal thing. I don't think there is much chance that significant science will change its individual nature. Leonardo da Vinci and other great artists employed large teams of assistants. So do the particle accelerator people. But individual scientists will continue to point out the great new ideas of science.

My recent trip through the USSR confirmed that the pressure for individuals to publish is even greater there than it is in the US. In the Soviet Union you have to publish *before* you get your doctor's degree. Even the Russians recognize the glut that this requirement has created in their own journals. Certain journals, such as *Zhurnal Fizicheskoi Khimii*, already carry abstracts of papers placed in depositories. While Russian information hardware is still relatively primitive, they will catch up with us one of these days. The USSR's commitment to the information function is significant. In Irkutsk and Novosibirsk every lab has an information specialist assigned to it. The restrictions on travel make it all the more necessary for Soviet scientists to depend upon other means of gathering information. So I believe the USSR can become a significant market for the information industry if we try to sell them the services they require.

The competition to publish in Russia and in most other parts of the world will tend, eventually, to improve the quality of articles. Less significant reports will go into depositories or other substitute forms of publication. Hopefully, the poorest material will remain in authors' files. The publish-or-perish syndrome has a tendency to elevate the importance of publication counting. But I think that more people will begin to understand the difference between counting numbers of papers—which is a straight quantitative measure—and citation analysis, which is more of a qualitative measure.

The *percentage* of growth in the literature will continue to decline. But world-wide, the *absolute* number of articles published each year

will continue to increase. This will make review articles even more important, and there will be a vast increase in the number of review journals.

As I mentioned before, the *printed* journal will, for at least 10 to 20 years, remain the principal form of scientific publication. However, we will also have various kinds of electronic data banks. In some fields we may even have totally electronic editing, switching, and distribution of manuscripts. And computerized typesetting is so commonplace today I don't really consider it futuristic. But what we take for granted in the United States is frequently something new for the rest of the world. For example, my colleagues at VINITI in Moscow demonstrated their new *Digiset* system for producing their *referativnyi zhurnaly*—or what we call abstract journals. Nevertheless, while computerized typesetting may now be an old idea, its use in the US and Western Europe, no less than in the USSR, is minuscule compared to the volume of material composed by old-fashioned methods.

If nothing else, vested interests like printers and advertisers will keep printed journals going. The inertia of the international postal system will also tend to maintain the status quo. The post office defines a journal as something printed on paper. Therefore, it isn't about to subsidize, through favorable postage rates, the distribution of journals that switch, for example, to microfilm. And even our copyright laws don't yet recognize non-print information technologies as significant. This type of thinking works against the more rapid evolution of journals into new forms of communication.

Eventually, however, I can visualize scientists using voice synthesizers to listen to papers while driving to work. Even now, one can hear some conferences on cassettes. But print substitutes like cassettes must be reduced to hard copy in order to quote the material authoritatively, and access to non-printed forms is often too slow and cumbersome for reference purposes. On-line storage of the full text of papers may overcome such difficulties.

Many of the systems that emerge will require considerable sophistication in their use. So the information industry will face a real "education" problem. This is where the National Science Foundation and other organizations can play a very important role. But the IIA is going to have to be there to prod the education establishment to get in line with the times.

In particular, universities are incredibly behind. We have very few examples in this country of what is probably the university of the future. I saw one such university, Tsukuba, in Japan. It was planned by a group completely dedicated to the information revolution. Everything in that university will be geared to whatever the information industry can do for that student body and faculty. Eventually the entire Japanese educational community will be affected. The Japanese have not left us behind yet, but many influential people in their educational system are providing them the kind of leadership neces-

sary to make the transition.

Switching from the academic to the consumer community, I think that two-way, on-line communication between citizens and computerized data banks is now imminent. The technology already exists to convert your home television set into a computer terminal operated over your regular telephone line. In less than 10 years, more than one million private homes in Britain will have access to information banks that would boggle the imagination of H.G. Wells. Through the British Post Office system called *Viewdata*, there will be in-the-home access to potentially billions of pages of stored data. That is more than enough capacity to store a whole library, including encyclopedias, books, and journals.

A development like *Viewdata* can be expected to have far-reaching social significance. A whole new relationship between people and their television sets will be created. Instead of passively absorbing whatever images cross the screen, viewers will be able to control the information presented in a much more selective way. No longer will the average citizen live in the "thumb index" era of information retrieval. What I mean is that with printed reference tools you have to use your thumb to access randomly chosen information. The *Viewdata* system with its keyboard will make it the "index finger" era.

Whether services like *Viewdata* can replace the newspaper and other print media remains to be seen. TV has already changed their role, but they continue to survive. In fact, the brevity of *Viewdata* items may whet the appetite for the more complete accounts published in newspapers and magazines.

I am positive that these new systems will precipitate at least one reaction: an increase in the perceived need for knowledge of broader kinds. And this belief leads me to the last point that I will make in trying to project what I consider to be a very positive future for the information industry.

There is a particular economic significance to the information revolution. In our increasingly information-oriented society we are moving away from physical and toward intellectual labor. As this happens, we can observe one peculiar characteristic about the information that we generate: it is very perishable. That's just the kind of thing you need for maintaining employment. When you produce more potatoes than the population can consume, you have to start dumping them. The perishable nature of information makes it possible for you to just keep on producing it. There is no let-up. There is no end to what science can explore. There are unanswered questions that come up all the time. That's why I think that this basic ingredient of our business—the perishable commodity we produce—may prove to solve the problem posed by Marxist analysis of capitalistic society.

Thank you once again for this award. As you see, I believe that the information industry is going to thrive for many decades to come. Indeed, as Machlup and others have been trying to tell us, the information society is already here.