Reflections on Our Future

Editor’s Note: At the recent ASIS Annual Meeting in Baltimore, Charles (Chuck) Davis, Indiana University, moderated an incredible session featuring leaders, visionaries, researchers and academics in the field of information science looking at the state-of-the-art today within the context of what it portends for the future of society, as well as for the information profession.

What follows is an edited transcript of that session, offering a taste of some of the comments of each of the participants. What it cannot do, unfortunately, is impart the level of energy and enthusiasm that was apparent in the room as the session was underway.

And while Chuck’s role is diminished in these excerpts, the editor wishes to assure all that it was Chuck’s flair and leadership that allowed the session to unfold as it did.

Participants: Candy Schwartz, Simmons College; Gary Marchionini, University of Maryland; Douglas Engelbart, Bootstrap Institute; Belver Griffith, Drexel University; Clifford Lynch, University of California; and Eugene Garfield, Institute for Scientific Information

Chuck Davis
Indiana University

Thank you for coming to the session called "Reflections on Our Future." What I’ve tried to do here, somewhat in keeping with the Annual Meeting theme of complexity, is to put together a panel of respected and likable people with whom I wanted to share views about where we are going. One of the major things I wanted to do was to reflect on the obvious, that we are living in extremely interesting times—similar, perhaps, to the incunabula period following the invention of printing with movable type. What we want to look at are the scientific and social consequences associated with contemporary technology.

To start I would like to entertain this notion that we’re living through interesting times. And I’d like to discuss, among other things, whether our innovations are driven by technology or science.

Candy Schwartz
Simmons College

The question according to the program is “Where are we headed as an increasingly information dependent society?” and I am actually not going to address social, economic or political issues. I decided to address this from the point of view of someone in the trenches, like a normal, everyday, not particularly technical person.

I am not convinced that we really are any more information dependent that we ever have been. We have been information dependent since the earliest days of recorded information. We have always depended on information and we have spent millennia trying to figure out how better to organize it, acquire it, store it, protect it and retrieve it. The problem to my mind is that we now have the opportunity to be paralyzed by information angst. Almost everything we do in our daily personal and work lives requires making choices from a larger set of possibilities, and the information we need to even find out what those choices are, much less which ones might be more beneficial, is all too readily available.

I do not care who is counting, or how they are counting, or whether they are off by several orders of magnitude—there is definitely a great deal more stuff out there than there used to be. And after the first 100 million or so objects, I don’t really see that much of a difference. Information stuff accumulates over time—it’s the nature of the beast. Knowledge accumulates to a lesser degree, but I think right now we are looking at information as a unit of discovery, still, rather than knowledge—and that may change. Usable information is more readily available, from many more non-overlapping sources, and unusable information is more likely to get in the way, since the haystack is generally bigger and the needle proportionately smaller.

What exacerbates this problem, and what introduces the angst, is the fact that all of this is much more “in your face.”
It used to be that while you might suspect that something else was out there, if you knew it was too much effort to go and get it, you wouldn't bother, and anyway, it would probably turn up in some guise in the things that you could look at. Nowadays, you cannot afford, really, not to turn over every stone, and I find there is an awful lot of mud and grit underneath those stones.

It's an even more scary thought that in our presumed desire to bring the Internet to everyone's home, and to reduce the information gap, we will be including all of those poorly socialized, but still functional, people whom we try to avoid at cocktail parties. That really is something to think about if you consider that only a small percentage of the world now has the ability to put information up there, and look what we already have.

Until recently, the channels by which information seeking was conducted were reasonably clear. If you needed to know when the next episode of Star Trek was, you looked through the listings for your five channels in TV Guide. If you wanted to arrange a vacation or a business trip, you either called a travel agent or you called the one airline that flew to the country you wanted to visit. And, if you were doing scholarly research, you looked in the printed indexing and abstracting services, DIALOG, ORBIT and the tables of contents of recent journals and conference proceedings, and you networked with your colleagues at the next conference you attended. I'm going to take these three examples and use them to indicate where we are now and where we are going to be. I hope.

Now, if I want to find out when the next episode of Babylon 5 is, I have to look through upwards of 100 pages of extremely closely printed type, covering listings from about, in my case, 80 stations operating 24 hours of the day. I do it, but it is not pleasant. On the other hand, if I miss it, I can go to the Web for a summary—a complete screenplay, pictures, maybe some video—and I can find out who has it on tape, and I could not do any of that before.

If I am planning a trip to Portugal, I can still go to a travel agent, or I have to choose among five or six airlines that are competing for my business. I have to consult eight competing guidebooks, which all purport to give me the best information about hotels available. On the other hand, as I could with Babylon 5, I can go to the Web and find more information about hotels, I can check the airlines and their deals online, and I can find travel remarks on the places that I am interested in visiting.

If I need to research a topic thoroughly in library and information science, I need to check the journal and conference literature on DIALOG, where I can now get full text. I can also scan tables of contents, search E-journals through several avenues, shift through roughly 20 sites which purport to organize the information sources on the Web in library and information science, and network with my colleagues in person and on list serves.

Now, let us move forward about 15 years. I am still watching television, I presume, or some 3-D or holographic equivalent. I have programmed my television to display a schedule for the week of the shows I like to watch and to suggest things I have not identified, but which seem to bear some relationship to the shows that I do like to watch, according to some similarity measure. In fact, I can probably choose when I want to watch any show, but the television software is interfaced with my scheduler and has decided what would be a good layout for the week for my viewing pleasure, given what it knows about what the rest of my week is going to look like.

I am planning a major trip. I still like to make my own hotel selections, but they are presented to me ranked by features which I have identified as being important to me in selecting hotels. I can get information from my fellow travelers very easily. I can see video clips of the rooms and video clips of what surrounds the hotel and so on. The 10 competing airlines of the world offer me deals in which I consider not only cost but comfort, speed and scheduling.

And for my final publication, I visit one or two digital libraries specialized for my field, and I chat with my colleagues in a virtual conference (which, by the way, I think is a wonderful way to have faculty meetings, and that is what I would like to see chat rooms used for soon).

That being said, these are the things that I think will have to be addressed in order to do something about the information overload we all feel. The technologies of delivery are obvious points. Transmission is going to have to become faster and larger. It is going to have to be delivered to me at higher speeds. It is going to have to be delivered to me wherever I am. And I am going to continue with the feeling that if I cannot get it in my desktop I am not going to bother, so information will have to come to my desktop, wherever my desk happens to be at any moment. This also implies a great deal of conversion and storage. The delivery mechanism, the machine, will have to become ubiquitous, and I suspect that TV will probably become an important method of delivery.

In terms of organization, which is the area in which I mostly teach, metadata standards will be developed, worked on, improved. Surrogation will still be needed and, perhaps, more so for speed of analysis, for browsing, for selection purposes and also, of course, for non-digitizable objects. I expect to see more in the way of automatic synthesis and reduction to make it possible to actually start to view knowledge and have that be the unit of retrieval, or the unit of interest, rather than the resource itself. Search engines are currently crude, and there is not much overlap when you get "good stuff" from many sources. It is different good stuff from eight different places, which is what we have seen in the online searching world as well, but I think if efforts such as the TREC projects continue, we will continue to make searching better in many different ways. Research into the human computer interface, browsing, visualization and all of those things that I am really enjoying seeing now
were hypothesized by people like Lauren Doyle 30 or 40 years ago. I think these types of tools will put the appropriate layers on top of searching algorithms to make them more useful for every day purposes. Filtering is going to be a focus of research for obvious reasons, and that is something we are now beginning to hear a lot more about.

And, finally, I think we'll need a new piece of jargon to describe the next net. We have the Internet, we have intranets, but what about the governing paradigm for my desktop? I presume that in no short order—and I believe that work in this area is being done by Netscape and Microsoft and others—there will be the desktop net. That is, everything you do will be governed by the same net-like or browsing-like interface, however it develops. So, I would guess that we will begin to see a piece of jargon, which may already be out there—something like desknet or selfnet or micronet or personnet or menet, which is the one I like, or mynet. I think that is the last little piece of jargon that will put some of this into place.

So, that's what I want to happen. Thank you.

**Gary Marchionini**

**University of Maryland**

Wow, how can I follow that? I'm really awed to be here with such a distinguished panel.

A window of opportunity has opened—the information society and information culture. I wonder what we are doing about it, how we are capitalizing on it. And that brings me to serious reflection on how I'd like to see our field continue to develop. And I'll try to be maybe a little provocative to generate some discussion. There are three areas that seem to me quite important for us to think seriously about in terms of research and development in the field of information science.

First, and you know I'm biased on this, it seems to me that human system interaction is core to our field. We have one of the founders of this field up here with us today [Doug Engelbart]. Thanks to leaders like Charlie Meadown, we have for many years welcomed human-computer interaction (HCI) type papers at our conference. But, it's an area that really doesn't have a home. Computer science sort of looks with some suspicion on HCI as being, well, not really hard-core computer science. Certainly there are exceptions. Psychology looks at the field of human factors as being sort of within psychology, but also it's only part of what they do. And, to me the real interesting work is in the interactivity. And that's where, I think, we belong, because we are, by definition, interested in intermediation—intermediation is dependent on information exchange.

And when I say human-system, I like to broaden it from human-computer interaction to human-system, because I think the things that we should be studying are not just you sitting there tethered to your workstation, which is a fairly dated way to consider interactivity, given the mobile world we're moving into, but how we interact with other people, and more importantly, with institutions. And so, developing ideas about the institutional interface, the way that we are able to work with bureaucracies that continue to grow and develop, and insulate us with more layers of technology, rather than people. You know, you used to be able to call Social Security and actually get a voice. I mean a real live person. Well, you're now insulated by many layers of phone mail technology. How we can continue to develop as individuals and as a society and yet have all the technical efficiencies that we'd like to have, I think, is a serious problem for humankind and it belongs in our field.

The second area that seems to me to be very essential for us to be more serious about, is to move beyond text. Clearly text is not going to go away. It's a fundamental form of communication for us, but increasingly the world of sound and images is just permeating what happens to our children from the earliest days of their lives. Developing visual and audio languages, assessing how they influence the creation of knowledge as well as the storage, retrieval and use of knowledge, is quite essential for us.

Along these same lines, not only do we need a broadening of the media types that we're concerned with, we really need to broaden out and be more proactive in how we think of information. We've, for a long time, tended to focus on the storage and retrieval aspects, which clearly are important to us, but we also need to be involved in the actual creation of information. I like to encourage people to think more deeply about ways that information science research can address the creation of knowledge as well as its use once people have gotten it out of the Web by whatever means they use to do so.

I've been very interested in developments, especially in the European community, on ways to try and add visual cues and iconography to the development of text right from the start, so that people are able not only to better express their ideas in a multi-modal sense, but, also, so that we can retrieve things better. We'll have alternative views into these increasingly large data corpuses. And also, more importantly, people can better understand and extract the meaning that the author intended if we have some of these visual cues along the way. The analogy that has been used is that when composers write scores, they can add dynamic notations to suggest how the piece should be played. The notes are the same, but clearly an individual artist will interpret those notes in special ways. Sometimes the composer really wants to force the player to play a particular passage in a certain way. Likewise, we need to enrich our own expressions in ways that are beyond the existing textual punctuation marks we have to visual and auditory punctuation marks. Electronic technologies open up entirely new doors for us to begin to do that.

The third point is more abstract and perhaps reflects a sense of frustration. It seems to me that in our field we really need to focus a little bit more on [the mental capacity for knowledge—] Aristotle's view of the world—[than on the nature and origin of knowledge—] Plato's view of the world.
We have a lot of very fine intellects in our field who create theories and who are able to do us a great service by propounding principles, even guidelines sometimes.

But, what we haven't taken too seriously yet, although there are, I think, awakening signs that we're beginning to pay a little more attention to practice, to trying to understand the applied wisdom that we have individually and as a collective. Finding ways to study this applied wisdom and apply it in new directions is, I think, very important for us, if indeed we are not going to get stuck in one of these local maxima and die out as a scholarly species.

So, my encouragement is to attend to the applied research track a little bit more than perhaps we already do, so that we really can make incremental differences. Because if we're not actually building things and demonstrating that they work and then accessing them and going to the next level and using iterative kinds of approaches, then we're in danger of becoming irrelevant to the world in which we live. And so, I hope that will generate some controversy. But, it seems to me essential to our long-term survivability that we have a more applied focus.

In summary then, what I'd like to suggest is that the infinite variety of possible interactions among systems of people, technologies and institutions represents a genre of complexity that will challenge information scientists for generations to come. Being the optimist, I think we really are not only at home in the universe as a species, but as a society and as a group of individuals who work in this field called information science. We also are at home in our universe of scientific and human endeavors and I believe we will be for a long time.

**Douglas Engelbart**

**Bootstrap Institute**

Well, thank you. I have an interesting association with ASIS. The very first professional paper I published was with ADI [forerunner of ASIS], I guess it was about 1959, and related very much what Gary was saying. The theme of it was, "Hey, you librarian people, etc., the producers of your information, that world's going to change a lot with the computerization of its generation. And the world of your users is going to change a lot. And you can't sit there in the middle of that thinking you're going to just be monitoring the same kind of freight and storage as you used to." It was a fun paper to write, but I think there was one review and it focused on my example of edge-notched cards as a primitive example.

Then in 1969, we were lucky enough to be able to put on for ASIS a live presentation and a video-projection of what we were doing and proposing. On that system we were showing hypermedia interaction, viewing people from our laboratory, their faces would come up and they would be showing what they're doing and we could interact on the screen. I was trying to give a picture of what we viewed was going to be the future. We'd done that a year earlier at a computer conference, and those were, for us, just big hopes. But, they made a little bit of a blip and then nothing. Similar things in the coming years really began to teach me about the term paradigm. And that is, what is the prevailing way in which people perceive their world and the future. And if that paradigm, which often is narrow enough just to be practical about coping with the days in the world we work, if that paradigm doesn't expand far enough to take care of the imminent future, then your ability to plan for that future and deal with it is very much inhibited.

Well, digital technology has been changing so fast that the way in which our society has dealt with its evolving paradigms just isn't up to being able to include even the near future. And, now it's not even being able to include what's here, technically. So, it became clear to me that that was a dominant problem in the world.

Another relationship with this conference that really struck me is the term complexity. What triggered me into taking this very divergent career path in 1951 was realizing the world's problems are becoming more and more complex and more urgent, and they need dealing with—the serious ones need dealing with collectively. And man's collective capability to deal with complexity and complexity wasn't evolving and maturing to keep pace with the complexity and urgency of the problems and the challenges. Helping and contributing in any way to improve that capability was and is something that I could invest my career in. So, that's what I did explicitly. Quitting my job, taking my new bride, going up to Berkeley to study computers, etc. That picture's been dominating for me all the years since.

And as I experienced more and more, the paradigm issue and problem became clear to me in the 50s. Because I was interested in computers becoming cheaper and faster and more available, I did a study on how the scaling down of electronic components would probably be done. And that introduced me to a world of people studying the impact of scale change on environments. And everyone sort of knows that a scale model of an airplane is not likely to fly, because at different scales physically, things operate differently. The design of you people would be very nice for the five- to six-foot model, but if you were fifty-foot models, your design would just not work. You couldn't even stand up. If you were the size of a mosquito, you could probably flap your hands and maybe fly. You get surprises when scale changes beyond a certain point, change beyond where your intuition would guess.

So, when I looked at this tool-system, human-system thing, I said, "The scale on the computer, the digital stuff, is just going to erupt, and if that happens the adaptation of the human-system side is going to have all kinds of surprises." And that just stayed with me all this time. Trying to tell the world about these surprises doesn't do you much good, because trying to tell people the paradigm isn't right, just doesn't work. It's sort of like becoming a political radical. People see you coming and they move or change the subject.

So, we were very lucky to get money from ARPA and others, starting in '63 and '64, and we actually could build a system. I said, "Hey, one of the surprises that's very important from my point of view is, if you're going to be more collectively capable, we want to improve the intellectual capability of harnessing your brain, especially collectively." So, I looked and thought, "What's that going to
be like? And I considered externalizing your concepts. Oh, great! You do it on hard copy, but what's the advantage you will get in putting it into a computer?" It'll easier to get there and the computer structure could actually model the conceptual structures in your mind.

The first thing we built had hyper-linkage, structure, all kinds of optional viewing for once you're in there moving around, and collaborative capabilities. We had all that working in 1970 when I volunteered, because I was in the ARPA community, to be the online information center for the network. So, they made me the second node. And what happened is we had that hypertext stuff all available for usage, and hypertext electronic mail, that could interlink, etc. And we could not get any of the other participants in the ARPA community to use it. Everybody just said, "That editor is horribly complex. We [especially the AI people] will make our own editors." But, it's more than an editor.

By the mid-70s we actually got judged to be going very much in the wrong direction and lost our research money.

The only way to survive with the system we had, which was supporting customers at the time, was to be moved out to the commercial world. The whole organization got sold to McDonnell Douglas, which was building an information systems group. We insisted that we keep and use the system ourselves, so our source code is hyper-structured and inter-linkable and on and on.

We had our own library system, in which you submit something and it stays available and can be cited from any of the 20 servers around the country, and it has a name of a journal, and its journal number, and there's cataloguing and you're guaranteed to get back what you authored, at that time. And you could interlink to any object in there. So, it proved by experience an immensely valuable thing.

But all of that died because the paradigm couldn't accept it. If IBM, Hewlett Packard, McDonnell Douglas and DEC weren't doing it, it's suspect. It just became clear that only experiences can shift paradigms; it doesn't do to tell people—you've got to give experience.

So, we worked up this system that we called bootstrapping, and you guys in ASIS are part of the scene. We at the Bootstrap Institute say the world has one category of people who are operating and another category of activity that's improving the capability to do that work. So we called the first part the "A" activity and the next part the "B." The "B" is that which is busy trying to improve how capable you can be at "A." Because we have significantly more challenges coming, we must get a more effective "B" going to cope with that change. To improve the capability for doing "B," you obviously have to add a "C" to improve your capability to improve. We already have a lot of "C" activities. You guys are embedded in it right now. Well, the "C" world is usually a community of people operating. Can you fix it so you can augment communities? Of course, that's what we really pushed in the collaborative, distributed work by being on that ARPA network for some important work. So, what we're telling people today is, "Look. It'll be very important for the 'C' activity people to say, 'Hey, we better start doing what we're preaching.'"

So, why isn't ASIS really busy, augmenting its own capability, because, its way of working in the future is going to be a lot different. And if it stays the way it is now, pretty soon we'll have an empty room, because who wants to go to all the trouble of travelling to get together. While once in a while it's important to have that personal bonding, more and more the importance of what ASIS can do, can be done a lot more effectively if you really get a network going.

We find that we really love going out to organizations. It's a very different thing approaching and saying, "Let me tell you what you ought to do." They look at you and say, "Don't you do heavy knowledge work?" "Oh yeah, but I'm here to tell you..." "No, why don't you show me how you're doing it?" So, you as individuals and ASIS as an organization are going to be in that position to go out there and tell the world what they ought to do and they'll say, "Ha! If ASIS is really going to do that, why isn't it an example of that different institutional way of working?"

In the Bootstrap Institute we're really trying to get that word out. We're saying, essentially, "team work is very different, so let's try to get an open sort of environment of teams of teams." And a very important category of that is professional and trade associations. So, we can knock on your door and say, "Why don't you guys make an interface to this Bootstrapping thing?" We're getting some government and corporate deals going, and it's the challenge. Either that or figure out for yourselves how you're going to do it. But, our kind of bootstrapping proposes having a central thing that societies can belong to that would help teach societies how better to become professional societies by merging your experience and being a society in itself. So, that is the central kind of bootstrapping I see.

You guys would be an extremely important segment of that, because you're a rarity among all of the already existing "C" communities in the nature of what you're dealing with. And, you can shift a little bit away from information toward knowledge as the core. The center of all our future activities will be a dynamic depository of knowledge packages, based in the document. The new document of the future is going to be the knowledge-carrying thing that evolves and directs. And it's going to need some really careful thinking about what the standard form of that future document is going to be. It's clear that it's going to be hyper, and it's going to need some other things to become a really effective generic, widespread, inter-operable, knowledge package system. So, that's part of the challenge.

Belver Griffith
Drexel University

I've been brought into this through the efforts of an old friend, Susan Crawford, who asked me to write a preface to a very fine book that she was doing with Julie Hurd and
Ann Weller. The book will appear next month: *From Print to Electronics: A Transformation of Scientific Communication* (Information Today, 1996). Well, I'm a seasoned expert in dubiety, you know. I guess to put it in a nutshell, remember that technology wonks said that the Titanic was unsinkable.

I'll tell you one personal anecdote right offhand. My oldest daughter is a very fine astrophysicist and she does exactly what everyone has been doing for a century. She publishes in *Nature* and *Science*. My information overload starts with my desktop. With the exception of two Maine coon cats, all of my immediate family have to be reached long-distance. For about a week, while I would be having a pleasant discussion with someone very close to me, my big machine was trying first, to answer the phone, then, second, to turn the whole conversation into a fax. I managed to kill the fax, but somehow someone set up the answering system to come on—I think my wife did it, and considering she's probably purchased and managed about $30,000,000 of computer equipment, I am indeed impressed by that achievement.

I've long been concerned with scientific communication, and there's a critical thing here. There's a great difficulty in maintaining a broad system for science that rewards an incredibly fragile commodity, namely creativity and original discovery. Just read up on your Bob Merton or some of my overviews, or brush up on your Shakespeare before thinking about scientific communication. There are many less demanding forms of technical work, of course, and many of those can be facilitated.

The other thing I'd like to say, and maybe people will disagree with me, is that there's a sharp distinction between necessary computerization and necessary text. Gigabytes of data require computers; arguments, text arguments, must be carefully written, carefully edited and carefully considered. They must be scanned, compared and presented at different levels of summarization and accessible at the four to six hundred word per minutes that we use in reading. My big machine drives me nuts. It takes me longer to find a frame of documentation than for me to read it.

Lastly, you are getting into a lot of technologies that make you realize that paper wasn't so damn bad. You can handle this stuff on an eight-ton displacement boat. You can't handle it on a beach, at a campsite or on a one-ton displacement boat. And, since I like to be in several of these different places some of the time, and still like to be able to think, I often am very, very pleased to have a piece of paper to read and write on.

**Clifford Lynch**

**University of California**

It's nice coming fairly late in the progression of speakers. I took to heart the organizer's invitation to speculate on how technology and social developments may interact into the future. And I wrote down about eight or nine points about this that are very much on my mind.

One of the things that strikes me, and maybe this is a funny thing for a technologist to say, is that as we look to the new digital communications and authoring and "reading systems," what we're really going to see is the emergence of a set of new genres of communications for those systems. These are really convention structures, rhetorical structures, ways of presenting and framing arguments, of conveying knowledge and ideas. There are likely to be genres that are driven a great deal by the ability to incorporate multimedia, to move away from the tyranny of text. They are also going to be impoverished by things like the limitations of computer screen size. I think that we're in a very interesting time now, that it's really not since film and video that we've had the opportunity to look at the emergence of major new genres for conveying ideas and information. It's striking to me how primitive and limited some of our thinking in this area is, and how little technology has offered us beyond the most basic capabilities in the new media. I've had the dubious fortune of being involved in a lot of videoconferences at work, lately. This is basic talking heads. You have the relatively straightforward technical ability, right now, to interweave all kinds of text, commentary, little decorative sprites, whatever you want, onto these screens. But very little has been done in this area.

I think that one of the things that we're going to have to deal with in the next decade, I'm surprised we haven't dealt with it more so far, is personalized systems. We're awash in information and being communicated at at a hideous rate, yet our systems are one size fits all and stupid. They don't adapt to us. They don't learn about us. They don't learn about what we do. And as a consequence of that we're unable to delegate to them even the most imbecile and routine tasks. My reading is that right now the potential ability to delegate is something that sounds wonderful to people, and we wonder why we can't seem to actually do it. My fear is that within a decade, this is going to be a necessity as a defense mechanism, as a way of operating in an environment where we're all drowning in information and communication. Rather than being an enhancement to our ability to act, it will be a mandatory protective shield.

I'm struck by the fact that we're starting to incorporate sensors into a lot of things. Sensors are becoming part of the networks now. We're starting to attach sensors to people and the things around them in various ways. There are going to be a lot more sensors than people by the time we get all through, at least in the highly industrialized parts of the world. I don't think we've thought much about how that affects things. It's going to give rise to new genres of communication that interweave real-time sensing with sort of reasoned human product argument in text and in pictures. We're going to see data flows appearing as part of these new forms. Telemetry of various kinds. Things you can just watch go by and you or your delegated machines can take action based upon; data streams that can act as triggers. This, again, is
part of a new and richer environment that people are going to function and make decisions in.

I want to say a few things about unexpected social impacts. Privacy is going to become a much bigger issue in this technological world where everything and every action leaves trails, where even passive listening may be a very trackable action. We're seeing some very unprecedented things happen with intellectual property. Certainly, questions of ownership, and the extent of what can be owned, and for how long, is very much in flux; this theme underlies the debates around many of the legislative changes taking place or being proposed both in the United States and internationally. But it's not just the legal framework that is changing. Until now, we dealt with intellectual property primarily in the realm of law. It was social compact and political decisions that defined what could and couldn't be done with it. We're now on the verge of delegating a lot of this management and decision-making about what people can and cannot do with intellectual property to automated systems that have no common sense at all. I think that's going to be a very different environment with some very tricky social and economic impacts.

We're seeing the emergence of virtual communities that interact in very funny ways with real communities (that is, communities that reflect geography and related organizing principles). And, we're starting to recognize that these virtual communities have a great deal of power. As Doug Engelbart said, we get groups of human intellects working together more effectively and the results are very powerful. We're starting to see new ideas emerge about how communities can work together—ideas like community filtering of information. As these virtual communities grow stronger and more agile and effective, as they factor out geography, all of a sudden we're bringing together cultures and ideas and societies that haven't interacted very much into a very uncontrolled stew. I think international issues and issues of cross-cultural kinds of reactions to things, and indeed a question of political control of the destiny of nations, is going to come up very seriously, as geography continues to decline. It's interesting for me to note that while there have been any number of skirmishes about television and radio broadcasting crossing national borders, in the last year I've seen a number of countries getting very seriously alarmed about the Internet as an open road along which ideas and information can move. And starting to think real seriously about how much of that they want floating around on an uncontrolled basis.

Two final issues, and they're both sort of wild cards. We forget, sometimes, how vulnerable all this technology and information infrastructure is to disruption. I find myself wondering more and more as big failures occur, whether there will be some kind of backlash—whether we'll suddenly become much more cautious and formal about how and where we use information technology. We may, as one of the previous speakers suggested, realize that there are some things we have to automate, but we may become much more cautious about automating things just for the sake of doing so because of the vulnerabilities that this can introduce.

The final issue is I'm wondering when we're going to see the next sort of quantum breakthroughs in human-interface technology. My perception is, with the exception of some virtual reality technology stuff that hasn't really gone mainstream in a certain sense and is still very cumbersome to use or to develop content for, we've been in a period of incremental improvements, rather than radical breakthroughs for about the last 10 to 20 years. In fact, many of the last set of fundamental breakthroughs, I think, came out of the work that Doug Engelbart pioneered some years ago, and I'd be eager to hear some speculations about when we might see the next generation of real breakthroughs, what they might be and how they might change the rules about how humans use computers and how computers can benefit people and society.

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With Cliff Lynch sitting next to me, I remember that at a meeting I chaired here in Baltimore 43 years ago, I was the guy with the long hair. So I predict that Cliff will cut his hair by the time of the next meeting in Baltimore. In any case, Cliff, I admire your free spirit.

I told Hal Borko that I was going to use a famous quote, but I don't know who said it—"if you understand the future, study the past."

A lot of ASIS folks have been talking about the future habitually. I've never thought of myself as a prognosticator, but I keep getting invited to talk as though I were. At an ACS meeting in Charleston a while ago, I was invited to talk about the future. I traced my reputation as a prognosticator back to the 1970 ASIS meeting in Philadelphia. Mel Weinstock was still alive and he organized all kinds of musical events. But the main theme of the meeting was the "Information Conscious Society." A lot of the ideas expressed today reflect some of the themes of that meeting.

Based on Candy Schwartz's remarks, one might predict that ASIS will become a division of the American Psychiatric Association. That's if we survive the computer glitch. By the year 2000, we have to convert thousands of computer programs written as though the second millennium would never come. Last night on TV someone said that it will cost $800 billion to reprogram all the computers that are hard-wired to the 20th century. If that problem doesn't put us in bed with the psychiatrists, I don't know what will.

My career as an information scientist began here in Baltimore at Johns Hopkins at the Welch Medical Indexing Project. I was an arrogant young Turk back in 1951. The project Advisory Group Chairman, Chauncey D. Leake, was the ultimate renaissance scholar—an authority on amphetamines, Leonardo DaVinci and many other subjects. He advised me to pay particular attention to the scientific review literature. And that has been the inspiration for most of the work that I have done. If we had time, I would explain that in detail. I forecast that we are approaching the time when
we'll have algorithmic scientific reviewing and historiography. This is what research scholars need. My focus has always been on research scientists. They live in a world entirely different from this group.

The average research scientist doesn't use the Internet the way most librarians or lay people do. Among other things, the Internet is too often hopelessly nonspecific. In fact, searching alpha-numerics is mainly impossible. Think about the 10 million chemical compounds and drugs that have been reported in the literature, and how about a typical literature citation with volume, page and year. We have a long way to go before the Internet fully satisfies the needs of scientists, other than for e-mail or accessing full texts. I am the publisher of a newspaper—The Scientist. It has been up on the Internet for over four years. The full text of six years of data is searchable. I think it is the first scientific serial publication or journal that has been available in full text for that time. I don't think there is a single reader who has given up the print version. The electronic version is used mainly for searching and conveniently transferring information.

There are some strange consequences of giving the lay person access to this kind of scientific information on the Internet. I frequently get requests from people who think the publisher of this newspaper is the ultimate authority on every subject we cover. After we ran a story on Hanta virus in New Mexico, I was asked to provide medical advice for a reader whose husband had the symptoms of that disease.

I have a dilemma with the Internet. As a publisher, I want to be able to inform every possible scientific reader of the relevant articles that my paper contains. But, I still haven't figured out a way to do this algorithmically. You've got to look at every published article and try to find a group of relevant bulletin boards. Doing public relations this way is very difficult. I forecast that the career of information counselor is the wave of the future. I also call these folks information practitioners, especially in the field of medical information. ASIS does not attract such people because we're still on the same track we were 40 years ago. In those days I was called a radical for proposing that we change the name of the society from ADI to ASIS. Apart from the name change, I don't think we've really changed all that much. Otherwise we'd be ASIST by now. So, there will be huge groups of applied information scientists outside of ASIS unless we make some radical changes in our mission.

I mentioned the problem of specificity. The scientific scholarly literature is one vast interconnected network. The 25 million or so papers that have been published and indexed in the past century are the nodes. The 250 million cited references that ISI has processed are the interconnecting links. All of that will become navigable when everything is in electronic format. I'm glossing over all the copyright and licensing problems, but I still cling to my original dream of being able to search the literature interactively, traversing the network, going backwards and forwards and sideways—being able to look at a current paper and ask the computer to trace the historiograph backward or vice versa—start with an old paper and go forward. If we haven't made that possible in the next 10 years, I'll be disappointed. In that way we'll be able to fulfill the dreams of people like Manfred Kochen, H.G. Wells and others who worried about paying proper intellectual debts to our predecessors. Unfortunately, it often appears that we are very quickly forgetting that we have them.