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## Interactive Electronic Media

I am going to discuss two major new media: interactive electronic systems and video disc. One is already with us, although on a very small scale, and it is the kind of electronic media represented by PLATO and similar computer-based systems. Although one reads about it constantly in *Popular Mechanics*, the video disc is not here yet. It seems certain to come, however, and I will try to outline some of the basic properties of both these new media. Because I am not a librarian, I cannot point directly to the exact impact these media will have on libraries, but I will as a layman allude to the kinds of impact I think are likely.

In order to be concrete, I will present some examples of what is possible today with the interactive electronics medium. First, I will use the PLATO system of the University of Illinois as an example, and after having shown some examples of how such a system can be used, I will then describe some of the major aspects of publishing, distribution, royalties, copyright, etc., for this kind of medium. My discussion will then turn to video discs.

There are about 950 PLATO terminals just like the one to be used here which are connected to a large computer at the University of Illinois. About 300 of these terminals are on the campus and others are scattered around the country. In its normal setting the PLATO terminal does not have a video camera directed at it transmitting pictures to a television monitor such as we have here today. The PLATO terminal is normally located in a classroom, and more likely there are twenty or thirty terminals in that room, with many students and teachers studying and writing materials together. Although my demonstration will use only one terminal here this afternoon, I will show you

a few examples of the way such a medium can be used for instruction. I will then demonstrate some of the impact that this medium brings to communication per se.

The first example is a program used for primary school math curriculum, one which was developed at the University of Illinois on PLATO. This particular lesson comes from a program for approximately fifth grade-level children dealing with fractions. The program begins by asking my name. It then says, "You are the proud owner of a brand new pizza place" and asks me to make up a name for this place. Let us call it the "Library Pizza Palace." The task is to divide two pizzas among three children. The three children are shown on the screen with two pizzas and a cutter. If I point at one of the pizzas, it passes through the cutter, is sliced into three pieces, and we are ready to distribute the slices. I pick up a piece of pizza on my finger, and give it away; another one, and give that away. After cutting the next pizza and again dividing it, I think that I will have divided them all equally, but one child says, "I got a lot"; another says, "That's not fair, I should get more"; and the third, "I got my share." Now I must start all over again, so I will repeat the exercise and try to get it right this time.

What happens here is that the screen is so sensitive that, as I point, it allows me to pick up a piece and move it around. Notice how very interactive this terminal screen is. It responds almost instantaneously to whatever I do — and that is one of the unusual features of this kind of a medium. It will say, "That's fine," and ask me how much pizza each child got. I am invited to say that each received two-thirds of a pizza. We can then watch the children eat their pizza.

That was a silly example, but it illustrates one of a very broad range of techniques used in that elementary school math curriculum, and it is somewhat representative. Using PLATO is not a passive experience for the child, but a very interactive one.

I will take the next example from a college-level program. In some ways it is very similar, but this lesson deals with a fractional distillation experiment in chemistry, an experiment not usually done in the laboratory because it is too complicated, too dangerous, and requires equipment that an undergraduate laboratory does not usually have. It is expensive and it can explode. On the terminal screen are the pieces of the still to be assembled. I will pick up the condenser and put it where it belongs. Then I will take the flask, but PLATO says, "No, you've got to hook the take-off adapter on first." I pick up the take-off adapter and put it where it belongs. Now I can attach the flask. I go through many of the intellectual operations that I would in fact perform in a laboratory if it had this equipment. I will continue to assemble the rest of the still by putting the thermometers in place. Then PLATO says,

"Okay, I put in 100 milliliters of a 50/50 mixture of pentane and hexane. What do you want to do now?" I reply that I would like to distill, but it says "No, before heating the oil bath you'd better add a boiling chip." I do, and then PLATO says, "And now what do you want to do?" I again say I am ready to distill. "No," says PLATO, "now you need to turn on the cooling water. If you don't do that you are going to be in trouble." I add cooling water. "Fine. Does it go in the bottom or the top of the condenser?" I answer that it goes in the top. PLATO replies, "No, it doesn't go in the top, it goes in the bottom; otherwise it won't work." The cooling water is added at the bottom. PLATO asks, "Now what do you want to do?" I answer that I would like to distill. "Oh, all right, fine. Remember that as you go, you're going to have to control the temperature and you're going to have to take off fractions as they distill out."

This is what happens. I will heat the oil bath, which will cause the liquid to boil off. As it hits the cold condenser, it condenses into this flask, so that the most volatile substance comes off first; that is what collects here. I take that off, put another bottle on there, collect another fraction, and so forth. In the lower left-hand corner of the screen, PLATO notes the temperature, which is presently 20° C. It says, "Warm the oil bath until the distillation starts." I will warm up the bath: 25°, 30°, 35°, 39°, 44°, 49°, 54°. Distillation has begun. The substance distilled out into the condenser; however, it stops again because I have allowed it to get too cold at 54°. I have already boiled off everything at that temperature. I can take a sample and warm things up a bit more; again the distillate comes off. I can remove a sample, then warm it up. A graph is building up of distillation fractions. I warm it up to 74°; "Oops," says PLATO, "you just blew up the still because your bath temperature was too high. Let's put the apparatus together again and repeat the experiment." Here the lesson returns to the beginning.

Note that in a few minutes I was able to go through the basic intellectual components of what is done with this kind of a still, without getting hurt in the explosion. That example represents another type of use of PLATO. Again, notice that the hallmark of this program is a high level of interactivity. I started a process and was interacting with it in real time as it proceeded. I had to make decisions as I went along and, as in the pizza case for the young child, so it is for the junior or senior in college: there is a higher level of interactivity than can typically be achieved with other kinds of media.

I have another kind of example. It is a lesson on "Introduction to Esperanto," prepared by my wife, Judith Sherwood, in which she attempts to use the graphic and interaction capabilities of PLATO to introduce something that a person has never seen. It is plausible to assume that those fractional pizzas are helpful to the children, but you already know that material. I am

using the following example because it may be something you do not already know. Material here is presented in a structure which recurs many times in teaching languages.

The lesson begins simply by introducing some nouns. First, flowers appear on the screen with the word "floro": and it is hoped that you get the idea. If not, you are asked to give PLATO that word. I type *f, l, i* — and am stopped immediately at the error. This is made available by interactivity. Here you can look at everything the person does and reply appropriately. Now I type *f, l, o, r, o*. Good. Next noun: "tablo." I am asked to type it, too. Now can you tell the difference? "Floro": yes. "Tablo?": Yes — and your reward is a "stelo," or star.

Having introduced some nouns, I can now introduce some prepositions. "Where is the flower?" "The flower is on the table." "La floro estas sur (on) la tablo; apud (beside) la tablo; sub (under) la tablo; super (over) la tablo." Now we will see a typical drill which is very easy to write and very useful in language studies. We are shown a drawing of a flower standing beside a table. Notice that no English is used in the presentation. We are asked, "Kie estas la floro?" "La floro estas." I will say, "sur," but PLATO says, "No. The correct answer is 'apud.'" There is, fortunately, an erase button on the keyboard. I can erase my answer. Notice that the program removes the correct answer, so that I must use my short-term memory to say that the correct answer is "apud." The program will now remember that I had trouble with that word, thus I will get extra practice on that word (a very common trick in these kinds of drills). Next I get different prepositions, each presented in random order. If you will watch, the "apud" example will recur at some time. I will get it right this time, and then I will not have to do it again. The lesson gets more complicated, with examples of nouns being "under," "beside," "over," and "on" other nouns. We teach a broad range of languages this way. A drill need not just be on vocabulary; it might be on grammar, sentence structure, or other language element. With these three examples I hope that I have given you some basic notion of how this kind of interactive medium appears.

I want at this point to say something about the distribution of such teaching materials. First, there is a tendency for materials of the kind illustrated to come in modular packages. Here is a lesson on fractions dealing with pizzas; here is another lesson on fractions, but it emphasizes conversions from improper fractions to mixed numbers. Once these lessons have been written, they can be assembled more easily in this kind of medium than can the chapters of different textbooks. That is the first point I want to make. Given this kind of interaction, teachers or self-study students can assemble their own book of chapters, and the chapters may come from disparate

sources. This is something that may be done to some extent with books, but, at least in university education, it is a little difficult. An instructor may use three books during the semester, but will use only chapters 2, 3 and 4 from one book, chapter 5 from another book, etc. He also may use another textbook, but substitute his own chapters for chapters 7 and 9 because the coverage is inadequate on those topics. In this electronic medium there is a tendency to write the chapters in such a way that different people can assemble the chapters in different orders to meet their individual interests. In particular, the person using this kind of medium will probably be using materials already in existence, but the teacher might want to add something of his/her own. I will take a very simple example, an avowedly contrived example, to show you how a local teacher might write such additional material.

Suppose I am a teacher showing a drawing of a triangle to a student and ask, "What is this figure?" The student will probably answer, "It is a right triangle." This is a rather dull form of interaction, but it might be useful under certain circumstances. How can I input that triangle into this medium for later recall? Because I want to set up what the student will see, I am offered a scratch pad by PLATO. I point at the screen and mark a point. I mark another point and others until I have drawn my triangle. That is what the student will see. At this place on the screen I want the student to see the text that asks, "What is this figure?" (Remember that there is an erase key to make changes in anything that is done.) Let us also put a little arrowhead on the screen to show the student where to type in an answer. That is the gist of it: the triangle, the question "What is this figure?" and a place for the student to type the answer. I will now also put a circle on the screen and state that I want to write in four times normal size, rotated 45 degrees. I'm going to put text on the screen that states, "Wow." I have now developed a fairly complicated display of what the student will see. Next, a program is written for me. I could have written this program by hand, just as computer programmers have done for twenty years or so.

This is essentially an example of automatic programming. I simply describe what I want the computer to present, and it writes a program for us. All I have to do to make it into a fully operational thing is to put in what might be one possible answer. For example, "It is a (right, rt) triangle," where "it," "is," and "a" are optional words, and "right" and "rt" are synonyms. Having inserted that into the body of this otherwise automatically generated program, I can now try it out and pretend I am the student. It appears on the screen, just as the student would see it. I am going to type: "a pretty tringle, right?" It says, "Well, you're close." The word *pretty* is marked as wrong. It shows us with special markings that there is a word missing between "pretty" and "tringle." "Tringle" is a misspelling, and

the word *right* belongs to the left. PLATO automatically gave me that appropriate feedback on the errors I made. Let me put in the correct answer: "a right triangle." It says "Wow" inside a circle. With these kinds of techniques, the local teacher can produce additional materials to augment whatever happens to be in the library.

What about the distribution of materials? First let me show you what we think of in terms of the physical aspects of distribution. We have a map of the United States showing the major sites of PLATO terminals that are presently connected to the Urbana center. This is a national network. A flag on the map does not represent a single terminal, it represents a cluster of them. For example, in one classroom at the University of Arizona, twelve terminals are connected to the Urbana center. In terms of communication costs, 950 terminals spread over an entire continent is a very expensive way to operate. In the long run, however, if this technique is useful, we can imagine that terminals will be located in homes as well as in schools, and a thousand terminals will be served by one large computer which is more regionally located. The present geographic distribution pattern is bizarre and anomalous, but regional systems have already been established in Minneapolis, Florida, and Quebec City. In the long run, we imagine that these kinds of services will be provided in the same way that telephone service is provided, i.e. with local exchanges in major cities serving the subscribers and customers nearby, and with connections among those exchanges. The Minneapolis and Urbana PLATO systems are already tied by a phone line through which curriculum materials and electronic mail flow. Regional centers probably will eventually be established throughout the country and those will share curriculum materials and other kinds of information. The distribution of the pizza lesson, for instance, would typically be handled as follows. Every exchange would have a copy of the pizza lesson. Any revisions to that lesson, and all newer editions, wherever they originated, would be passed from one node to another and would supplant the previous editions or, if the previous edition was also useful, they would simply be added to the catalog. The catalog would then contain two versions of the fractional pizza lesson. Multiple copies can be justified, for it is reasonable to assume that the information flow from one node to another (e.g., between the Urbana system and the Danville, Illinois system) may be slow and the institution should have a copy available in each place. It is the same justification for having a copy of the same book in each library.

I will show a map of Illinois on the terminal in order to give you an idea of the different users of PLATO. In Illinois there are terminals not only in university environments, but also in community colleges, prisons, industrial

training centers, and grade schools. As I stated earlier, about 300 of those 950 terminals are on the University of Illinois campus.

In addition to the problem of distribution, there are problems of creation of programs, of copyright, and of royalties. What can we expect? What are we presently doing? Unlike many media, with this kind of medium it is possible to track the usage of materials on a detailed basis. I believe that in Scandinavia authors actually receive some kind of usage fee based on the number of times their books are checked out of a library. It will be possible not only to identify and track usage sites easily, but also to know how many people have used the program, how many times, and for how many hours. With those data, it will be possible to return to an author some royalties as well as some detailed information on which markets have accepted his/her materials with the most interest. As a beginning, we are going to return a few cents per contact hour. Notice that there is a little difference here between this and the book market or the record market. In the book market, an author of a textbook is paid on the basis of the sale of the book, not on the usage of the book. The book may be used five times, and by making it possible to track actual usage itself, a slightly different way of calculating royalties is offered.

This field is very new for copyright. In this respect, about the only thing the university has done with regard to PLATO is to place copyright notices at the beginnings of lessons, which may mean nothing or it may mean something. To my knowledge, no one has yet actually made the effort to discuss copyright of interactive material with the Register of Copyrights. The solution may be very similar to the copyrighting of a videotape presentation of a television play — but it may not. In this medium, there is more difference between what appears on the screen to a user and the inner workings (i.e. the program) than there is in the case of videotape, where what appears is also what happened in the studio itself. With interactive programs, this correspondence is very slight. It may be that the external appearance of a program, i.e. what it looks like, is a copyrightable production or presentation; however, the inner workings of the program itself probably are not and perhaps will just be kept as trade secrets.

In addition to these questions, there are questions of cataloging. These are very new to both the Urbana system and the Minneapolis system, but there has been quite a bit of activity in cataloging work. Because of the nature of the materials, the cataloging of programs is of a somewhat different character than the problems of library cataloging. These materials tend to be short, single concepts, somewhat smaller entities which are more like the chapters of books than books themselves. What is appropriate for cataloging

at this "microscopic" level may not be entirely clear from library practice. We hope to learn from librarians about what we should be doing. It will be a long interactive process in trying to understand how best to present the catalog information that tells you, "Yes, the pizza lesson exists . . . it deals with fractions."

What I have shown thus far is that this particular system was built mainly for direct instruction. There are, however, other uses of such systems, uses which impinge upon the distribution questions. You notice that the word *notes* appears here on the screen. While I have been talking, someone has sent me a note — a piece of electronic mail — and I am going to read it. This is an interesting note. Yesterday a person in Delaware wrote to me to ask about attaching typewriters to the terminal for making certain kinds of hard copies. The question was not entirely clear, so I wrote back asking if the question related to the actual kind of typewriter the person used or how he programs the thing to use that typewriter. We received this note back from him today (notice that in the space of twenty-four hours, there have been two full exchanges of mail, which is otherwise hard to come by these days in Delaware): "We are interested in learning about your basic algorithm between PLATO and the external device and the device itself." I can now write back to him, saying: "Okay, I will write back to you later today. I'm giving a talk at the moment." By pushing the button, I have sent a note to Delaware. The next time that person goes to the terminal, he will see a little red flag saying that there is mail for him — just like a rural mailbox.

Another kind of electronic communication open to public and special-interest forums is multiway forums. Here is an example of a public forum. A fellow at Cornell wrote: "Look, I'm trying to write a program of the following kind. Am I doing something wrong? I did this and this and this, but it doesn't come out properly. What's wrong?" Someone in the math group says, "I tried it and it worked for me." Someone in Connecticut asks, "Is it possible that one of those numbers was negative, which would make it not work properly?" The fellow at Cornell answers, "Yes, I'm not sure about that," followed by someone in electrical engineering who says, "Well look, why don't you try this with such and such, and then that will prove it once and for all." This example represents not a one-to-one personal communication, but an open forum. This example happens to be devoted mainly to programming questions, but there are all sorts of special-purpose questions, from religion to technology, that could be discussed. This many-to-many electronic communication capability is a little different from any of the media we presently have.

Still another form of communication that is rather specific to this particular kind of device is the possibility of talking to people. For example, I



will ask to talk to a colleague named Dennis. If he is looking at his terminal at the moment, he sees a message saying Bruce Sherwood would like to "talk" to him. Actually, we will type messages back and forth to each other:

"Hi. Sorry to bother you; I'm in the middle of a presentation and would like to show people how you and I can talk this way. Say something!"

"Hi, Bruce," he says.

"Could you show us something on your screen involving some graphics?"

"Sure. Here's a graph showing student grades on the last exam."

What we are looking at here is what is on his screen, which he offered to us. It is as if we were looking over his shoulder while he worked. (To ensure privacy, a note at the bottom of his screen reminds him that I am looking at his screen.) An important use of this machinery is that of consulting on programming problems. The consultant can look at the screen of the person who is asking for assistance and suggest changes that should be made in the person's program.

Another kind of programming help available is an extensive on-line reference manual. If I want to know about how to draw circles, I just type the word *circle* and it gives me all the information possible on how to draw different circles, on parts of circles, etc. If I want to know how to handle various possible answers the student might give, it will tell me how to do that. This is the closest we have come yet to information retrieval per se in this system.

For reference services it would seem plausible to plug into existing commercial systems. Many commercial bibliographic searching services and other kinds of information retrieval systems are presently available. If the type of electronic utility exemplified by PLATO grows to a large scale, it could provide a window through its terminals into these existing services. For a multi-purpose utility, it seems only natural to consider the electronic medium as a window to a variety of public utility services.

I will briefly discuss some aspects of the emerging video disc technology. A video disc player could be connected to your home television set, and a video disc placed on the player like a record on a phonograph. One of the obvious uses of this technology is simply to show movies. A more revolutionary use, however, springs from the fact that instead of holding a half-hour movie segment, a disc could hold about 50,000 still pictures! When allowance is made for the relatively poor resolution of television, I estimate that twenty of these television pictures could encompass the text of one page of the *Encyclopaedia Britannica*. One video disc could therefore hold the results of photographing 2,500 *Encyclopaedia Britannica* pages, and 10 video discs would hold the entire encyclopedia. While this may appear to be a great deal

of information on one thin disc, it is not an overwhelmingly huge amount of information.

Another way of storing information which makes a video disc seem even larger is to store the data on the video disc so that one disc corresponds to approximately two *Encyclopaedia Britannicas*. (If one disc can hold one-tenth of an encyclopedia, while another disc holds two encyclopedias, the difference between holding one-tenth of an encyclopedia and two encyclopedias is a factor of twenty.) This compression factor comes from the following considerations. When this type of dot-oriented technological gadget prints an "A," it must be given specific information. It must be told that there is a dot at the top of the "A," a line of dots down each side, and another line of dots for the horizontal crossbar. About twenty or thirty pairs of numbers would be necessary to print the "A." In contrast, if the information is going to be limited just to text, then you need just one number (one through twenty-six) to indicate the letter you want. You simply say "I want letter no. 1," and the device looks into its innards and says, "Oh yes, character no. 1. That's an 'A' and it looks like that. What's the next letter?" There is a compression factor of twenty in the numbers needed to specify a letter. This latter scheme of encoding, using "character codes," allows for tremendous compression. It does not handle the pictures of the *Encyclopaedia Britannica*, but it does handle the text, and some mixture of text and pictures would be common. (You can slice the storage in other ways, too: if you don't want 50,000 pictures you could have 300 symphonies recorded instead!)

Capabilities of this kind suggest a possible future connection between computer-based systems and video discs, for video discs need not hold only static information. Because the disc could contain programs which, coupled with a little computer beside the player, could perform a variety of operations, there is a likely connection between video discs and home computers. At first these operations will emerge as being quite separate, but when the characters are encoded, it is likely that a little computer could look at those character codes and say, "Hmm, character no. 3, what's that? I look into my memory of what letter no. 3 is. Oh yes, it's a 'C.' I make a C like that." There will be, in fact, some overlap between the two new technologies.

The problems of distribution, royalties and copyright for video discs are quite different from those of the interactive electronic medium we considered earlier. For the latter, there is one centralized store with much information and a network to connect people. It is very good for keeping things up to date and for keeping people in touch with others. Video disc distribution, on the other hand, is likely to be decentralized like phonograph records: they may be purchased in a store or checked out of a library and then used on a local player, either in the library or at home. The economics of video

disc distribution, including royalties, are somewhat peculiar. At the present time authors receive royalties for books as a share of the selling price of the book. If the book sells for \$5, the author of the book gets \$.50 to \$1 — a fraction of the selling price. The selling price includes manufacturing, distribution and advertising costs. For a video disc which could hold two *Encyclopaedia Britannicas* and with manufacturing and distribution costs likely to make the selling price approximately \$10 to \$20, it is difficult to see how the royalty fees can be established to compensate the writers of all that material. Thus, even more than in the case of photocopying, there is a tremendous dissociation in that kind of medium of royalty compensation for authors and the manufacturing and distribution costs of the physical item itself. I think that this will create many difficult problems, and initially, public domain material will be used to fill those discs with huge amounts of information. Pirated editions are likely to become a problem. While reproduction may involve fairly expensive machines, as with phonograph records, there will be many people with such devices. Because of the volume of information that can be obtained from one of these devices, it seems to me that there are some really sticky questions here — much stickier than the photocopying question.

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### **Response**

**I** was very impressed with the demonstration of the technology presented by Bruce Sherwood and I suspect that others were, too. Before we acquire PLATO terminals for our libraries and place our first order for

video disc equipment, however, I would like to suggest that there are certain assumptions we should question.

My reactions are based on both notes I took from the outline of Sherwood's presentation given to me when I arrived yesterday, and notes taken during his presentation. My remarks will cover three areas. First, I will address that part of his presentation dealing with video discs; then I will offer a few ideas about education, about philosophies of society, and about how people learn, think and interact with one another. I will then attempt to tie these philosophies to the third part of my response, dealing with PLATO as a communication device (among other interactive electronic media) or as a specific medium that should facilitate the betterment of humankind.

I would like each of you to consider the following questions. How can you apply PLATO in your library? How can you, with a tool as powerful as PLATO, provide learning not only through drills, but at higher intellectual levels of study as well? Make the transition, if you will, to video discs — or to any kind of an information storage system that permits you to intermix sound, motion and still visuals, plus other kinds of information that were not mentioned. How will you apply these tools in your library? Answer the following question honestly. Are you presently applying current technologies of motion picture storage, still information storage or audio information storage? Based on my experiences with libraries, I am not optimistic that libraries are ready for PLATO — and they are certainly not ready for video discs.

In speeches given throughout the country, video disc production has been billed as a very low-cost, paperback approach to motion visuals and other kinds of information distribution. The prices that Sherwood has quoted and the prices that appear in print represent only the cost of production of the physical item, i.e. the disc itself. The costs that are incurred in the actual production of the average one-half hour, 16mm sound motion picture for the educational market account for only 60-70 percent of that motion picture sale price. A major portion of the cost of the film is the scripting, the production, the filming — everything that must be done prior to the release of the print. Therefore, one must add the cost of content production to the video disc cost and that raises the price to some extent. Admittedly, video discs can be produced for much less than 16mm sound films, but the \$25 print of *Gone With the Wind* will still not be available for a very long time.

I would like to question another item, but I lack the technical expertise to answer my own question. We have discussed the use of video discs as a storage device for the printed page. It is well known that existing television technology, including the technology of the video discs, has a limited number of lines of resolutions per inch. If we assume that a television set with excellent resolution will give 550 lines of resolution per inch, how many

technologists will settle for only 500 lines of resolution per inch on a microfilm reader? Therefore, as Sherwood has indicated, it will be necessary to use multiple frames of that disc to store one printed page. Why not use video discs or currently available, low-cost magnetic storage devices for storage of digital information?

The point I wish to make is that we are not making use of the options now available. I would suggest that at this conference, we should consider how we can apply existing options first, so that we will be prepared for video disc and PLATO. I am certain that many other innovative technologies can be identified that will be extremely significant in the future of library and information services.

I would like to reflect for a moment on a few comments I made based on notes given to me by Sherwood, since they relate to the basic philosophy of this conference. I asked myself why I, as an educational technologist and a library information agencies specialist, am concerned with PLATO. If we can assume that all of human behavior is based on learning as a result of experience, then I would speculate that libraries and information programs are concerned with that process. Libraries will support the human enterprise, i.e. learning. How do libraries support learning? How do we obtain and utilize information? At issue here is not only the storage, management and retrieval of information, but the ability to utilize that information to help solve the recreational, instructional, inventive, or other problems of humankind, as well. That is really the name of the game.

Our society continues to demand independence of the individual. Throughout this bicentennial period, we have often attempted to review the goals of independence. But look closely at what we really have: it is a dependence which is really an interdependence. Our libraries, I think, are philosophically based on the concept of intellectual interdependence. We try to use the intellectual products of others as we interact on the intellectual plane in order to solve problems, to invent, to learn, and to direct our behavior.

Sherwood has shown us only one interactive medium, i.e. PLATO. It is probably one of the most powerful teaching machines that has come into existence in a good number of years. PLATO is also one of the most fascinating teaching devices, because so very few of us have had the experience in our own schooling of learning from a "teacher" such as PLATO. Remember, however, that the content of PLATO is no better than the teacher's input into it; PLATO is only a machine, like Skinner's box for the pigeon, and can do nothing more than its human input enables it to do.

The question for libraries, therefore (and for myself, in educational technology), is: When are we going to learn to be as skillful as Sherwood and his colleagues in putting things into that box? If we do not develop that

kind of skill, will we be willing to depend on others to feed information into the machine in order to communicate and learn? I am not yet ready to answer that question. I feel that, in today's presentation, the stress was basically on the medium itself, on PLATO as an interactive computer system. We still need to examine its intellectual content. I am undoubtedly as guilty as many of you in focusing attention on the medium itself rather than on the content of that medium; think about that. Our concern is really for the information. Because the computer is such a massive filing system and is so flexible in its ability to access and to present information, we have the opportunity to learn by using a programmed computer textbook in a scrambled manner, just as Sherwood has done with PLATO. The surface of a large table could probably be covered with printed pages dealing with that one program; but this learning can be done with other devices. The medium that is best suited for the presentations that Sherwood gave us is tied electronically to this little screen as a computer.

Since Sherwood has written on the subject, I would like him to react to the related issue of cost-effectiveness. Consider PLATO in a public library setting, where it gives tutorial help to a high school student who wants to repair his car, or to an individual who wants to learn how to grow petunias. How does this compare from a cost-effectiveness standpoint (if it could be measured) to some other existing media which can do the same things?

While we are considering the public library — and I refer here only to the nonschool, noninstitutional library — I will pose another question. As the public library becomes more involved in direct teaching and increasingly supportive of alternative education programs (especially with the availability of powerful tools such as PLATO), will a conflict develop between public libraries and institutions such as universities, whose livelihood is based on enrollment? Will public libraries draw students away from the schools? I have purposely overstated this case in order to elicit reaction. This problem is a concern in many states. For instance, in some states, the university budget authorizations are based on the number of students on campus. As students begin to have options other than the campus for training in higher education, enrollments may decrease.

Another issue should be raised, although Sherwood surprisingly did not mention it. This relates to something on the horizon not only in education, but in dealing with the microcomputer systems. Today we are dealing with a megasystem that is horrendous. The computer capabilities you have seen here are greater than any of us will ever have available to our libraries. Libraries will have to buy computer support from sources elsewhere. Not too long ago, however, minicomputers came on the market. Some of you may have minicomputers in your libraries functioning as management support

systems. Some of those minicomputers can be used for computer-assisted instruction. The minicomputer is an alternative medium, and can be programmed just as well as PLATO is programmed. Given enough direction, the minicomputer will do as much work as PLATO.

What about minicomputers or, more specifically, microcomputers? I have not had any experience with microcomputers, but last week I was asked for my reactions to a paper to be presented at a conference to be held in 1977. In particular, I was asked about microcomputers and their applications in educational activities. Although I do not know anything about them, I do know that some of the media in the new technology are extremely small and can be hooked to keyboards — their potential is great. Perhaps Sherwood has the kind of background that can help us look at the uses of the minicomputer in the learning experience.

To the administrators attending this conference, I would recommend consideration of the problem of administrative support relative to the care and the feeding of PLATO. Who should be hired? What kinds of people should be hired? How many graduates of the ALA-accredited programs of librarianship are going to know how to handle this kind of tool? I don't know. In fact, I doubt that the Ph.D. graduate from the finest institution is yet ready to handle this tool. This fact scares me. If we are going to place these devices in the library for direct teaching purposes and for development by librarians, then we as administrators must know what is in that system, and for what we are responsible.

In closing, I would like to comment very briefly on copyright. Computer programs are, in fact, now accepted for copyright registration. This is a result of a 1971 amendment that grants copyright protection to recordings.

These comments represent fairly well my reactions to Sherwood's excellent presentation. The power of the technology that we have with us now is awesome, and I hope that we can continue to develop our ability to utilize it.