Interview of Joseph Carl Robnett (J.C.R.) Licklider

Interviewed by:
James Pelkey

Recorded: June 28, 1988
Arlington, Massachusetts

CHM Reference number: X5671.2010

James Pelkey: Having given you some background as to what I'm interested in, you were about to make a comment before I cut you off, and maybe --

Joseph Carl Robnett (J.C.R.) Licklider Well, perhaps, let's just begin with this. I was familiar with Paul Baran's work. I had encountered it someplace along the line, I think in an Air Force study group. I didn't realize that others in the ARPA Network Group didn't know about it until very late, so I think that Bob Taylor's work and Larry Roberts' work got pretty far along before they knew that there was a ten-year study of prior writing about this.

Pelkey: I presume by that inference that Paul Baran's work had an impact on your thinking about --

Licklider I don't think my thinking about this is all that pertinent. When I went to Washington, it was to promote and try to help develop command computer interaction -- interactive computing. The main approach to that was -- the basis was timesharing because we didn't have a richness of workstations and personal computers. There had to be some way to get the physical means available, and everything was so expensive it had to be timeshared. We set out to have six or eight timesharing systems in various universities and non-profits, and the idea was inescapable that these things ought to be tied to together in a network, but there really didn't seem to be a way to do that at the same time as we were building the early timesharing systems. So, we talked about it in a semi-humorous way, and the term 'Intergalactic Network' was a kind of intentionally grandiloquent way to express the idea, because we didn't really expect to get at that right away. It was all we could possibly do to make timesharing systems work. They had lots of bugs, and the schedules tend to slip a bit, so it wasn't very important whether I knew about Baran's stuff or not. We obviously weren't, while I was there, going to get that done. After I left, in July of '64, and Ivan Southerland became director of the office, and I think it was about all he could do to develop what I had gotten started and then intensify the work on graphics considerably. He did several things, but I don't think he tried to do much about the communications aspect of things. When Bob Taylor came after Ivan, then Bob looked around for the great thing for him to accomplish, and he got excited about the network idea, and it ceased to be funny; it started to be serious: "Where can we really get the money and the people and so forth to work on this?" I guess about the time Bob went there, I'm not sure of the timing here, Larry Roberts and Tom Merrill did some experiments between Lincoln and, I think, SDC, and Larry became really dead serious about this, so he went to be the chief scientist to Bob Taylor, and then when Bob Taylor left, Larry became head of the office, and I think the Arpanet was the main thing he thought about. He carried everything else along, but it was, therefore, 1967 or '68, I guess, before you could say that there was really dedication to do that. By the time -- I went back to ARPA in 1973, '74, I think if was, or '74, '75, I've forgotten which. By that time the network was quite well established' pretty large. It was possible then to use it for serious things, and one of the things I recall most is the Director of ARPA, Steve Luchesik had really come to know and love the ARPA network, and he had gotten all his program managers and office directors and so forth and gotten them to get their contractors on the network, so lots of things were possible, including, for example, for Steve to do micro management on everybody's project. It was even clear there were going to be lots of social effects and lots of changes in how business was transacted. Aim me at some other topics. I mainly wanted to get this notion that -- sure, we talked about networks when I was there from '62 to '64, but not in the serious way that we were talking about them in '67, '68, 69.

Pelkey: Right, but is not part of the process of research and certainly development, the putting forth of the vision of where things can go, and therefore other people can align themselves behind that and try to bring it into fruition.

Licklider Yeah, but what I didn't know at that time is that there was this tremendous difference between how quickly one can develop a vision and even communicate it, and how slowly one can implement systems of hardware and software, so that there is a strong element of frustration in all of this. People -- a group of people, six or eight people, who get together and in the course of an evening, or a day or two, dream up a pretty imposing technical system, and I guess one of the things that's missing is -- or was missing then -- how to characterize it accurately enough and completely enough that one can characterize five or six such systems and compare them and decide what one really wants to do, and we

simply didn't have that. I don't think it exists even yet, but computer simulation and modeling, of course, goes some distance toward that.

Pelkey: A very specific question relative to your second tenure at IPTO: were you involved in the process of when ARPA went, at that time I gather DAPRA, went to AT&T and asked them if they would manage the network?

Licklider No, I hadn't gotten back yet. That, I think, was during Larry Roberts' time, but I'm not positive. My recollection of that -- I should say, I was kind of trying to keep from looking over my successors' shoulders, so I didn't go every week or month to ARPA, but I did know the people well and hear what was going on. I think Larry Roberts was very unhappy with the telephone company for being and old stick in the mud. It was clear from his -- I didn't go to the meeting, so I don't know for sure.

Pelkey: Do you remember anything about this incident about the period of time after Larry joined IPTO as a program manager for the network and he started to formulate his ideas about what this experiment, if you will, should be? Do you remember anything about your interactions with either Bob or Larry during this period of time, in terms of their thoughts about what this network should be; how big it should be? What nodes should be on it? Or issues like those?

Licklider I don't remember all of that very clearly, I must confess, but I have the strong impression that Larry thought there was no little experiment that would be very helpful; that he had to have a network with many nodes -- a dozen anyway and probably 100 -- and that it had to be used for serious purposes, and that his problem was -- what he had to excel at as a manager was actually getting this whole ARPA community to make ten or fifteen percent of everybody's effort to get the network to go. He though he was in a good position, that he had not only the people who could build it, but enough people to use it, if he could only get them really focused and interested. He was frustrated that he'd shoo these researchers at his thing, and considered the network as kind of a diversion. I believe I was director of Project MAC at that time, and I loved the network. I had trouble with my people about it. They didn't like it, but I said: "I estimate as a minimum, ten percent of our effort is going to be the network. It'll just happen that way," and partly that was promotion on my part and partly it was true belief, but most of the others were much more interested in what they were doing than Larry's network.

Pelkey: Do you recall a meeting between yourself and Larry at Hot Springs? The Second International Congress at which Corbato was there as well?

Licklider Corbato and Fano were there.

Pelkey: Who else?

Licklider I don't know if it was the first one or the second one, Bob Fano, who was the first Director of Project MAC at MIT --

Pelkey: Which was your conception, right, Project MAC?

Licklider I didn't think of the name 'MAC.' I thought of a big laboratory at MIT. I knew I wanted that team of people. I had been at MIT before I went to Bolt, Beranek & Newman, and from BBN to ARPA, and then back to -- to IBM --

Pelkey: And then to MIT again.

Licklider -- to follow Fano. Fano had decided he was going to retire, so I went to MIT, and I was Associate Director for about a year, and then I became Director. Unfortunately, I thought I was going to get there just about the right time, really, to make a big push on the network, but Multix had fallen behind schedule, so my main task, actually was to get Multix completed.

Pelkey: Did Project MAC's original funding come from ARPA or did it come from the Office of Naval Research and other places?

Licklider Well, before there was Project MAC, there was research on timesharing by Corbato in the Information Processing Center, in the computer center, at MIT, and that was funded by ONR, Marvin Donecoff. Marvin Donecoff turns out to be at the roots of very many of these things; he and his ONR office were into almost everything, and the Air Force, the Air Force Office of Scientific Research, had funded Englebart, and that was a going concern before ARPA got its hand on it. The idea of getting an inter- disciplinary, inter-departmental lab at MIT was an ARPA idea.

Pelkey: Coming back to this meeting, Larry recalls this having been Hot Springs, which would have been the second Congress, and strangely enough, Paul Baran spoke at the first Congress and presented his paper on distributed communication systems.

Licklider Is that true?

Pelkey: Yes, and it was published in the IEEE in 1964. I have a copy of that paper, and yet most people share your impression -- Bob and Larry -- that they weren't aware of Paul's work even 'til later than that.

Licklider Later than that, I would say; somewhere around '67 or '68 - -

Pelkey: Absolutely.

Licklider That's my impression.

Pelkey: And yet he gave that presentation --

Licklider I didn't realize he gave it then.

Pelkey: Yeah, the first Congress, he presented a paper --

Licklider Have you seen his publications on this?

Pelkey: Yes.

Licklider I think there are 17 volumes of it.

Pelkey: Eleven.

Licklider Eleven volumes? I remember it was a fantastic amount of stuff. I never did read it all, but I read a lot of that.

Pelkey: Do you remember that meeting with Larry and Corbato and Fano?

Licklider Yeah, I remember. I can almost give you the talk I gave at that, if I have the right meeting. At the -- well, it was one of these big, old, resort hotels -- Green something. Greenbrier is it?

Pelkey: I think it was Greenbrier.

Licklider A bunch of us went down on a train. I drove back with somebody, but I went down on a train, and there was a lot of discussion about this and -- Fano says that it was on that train ride that he decided, yes, he was going to move his field of interest enough to be -- to put Project MAC together.

Pelkey: Was Larry Roberts on that train?

Licklider I think so. I'm not positive, but I think so.

Pelkey: Do you remember interacting with Larry at all?

Licklider At that meeting?

Pelkey: Yeah.

Licklider I don't remember anything quite that clearly accept the talk I gave.

Pelkey: Because Larry -- that was a seminal point in Larry's career -- of him getting interested in networking, because he wasn't interested in networking and communications at that point. He references you as having had a big impact on him.

Licklider This was a meeting that was put together by the people at MITRE, if I recall.

Pelkey: I believe it was.

Licklider MITRE got out --

Pelkey: [Reading from a document] This is a paragraph -- "Concurrently with is effort to bring forth interactive computing, Licklider began to think about the problems and benefits of computer networking. His dry humor was to influence the phrase he used for his concept, 'The Intergalactic Computer Network.' This was during a period when there were just a few shared computers in existence. While attending the Second Congress on the Information System Sciences in Hot Springs, Virginia, in November 1964, he had a profound impact on Lawrence G. Roberts. In informal discussion with J. C. R. Licklider, I concluded that the most important problem -- "

That's a quote from Larry. Does that bring back any --

Licklider Well, I can't totally confirm that, because I don't remember it well enough, but I remember that I was in a high state of enthusiasm for a number of things that were breaking at that time, and I kind of used that trip as -- partly as a recruiting trip.

Pelkey: That was 1964, so you were at ARPA at that -- you were (unintelligible)

Licklider I left IPTO in July, but that didn't change my enthusiasm any. When I went to IBM, I considered that my principal job was to move IBM into interactive computing, and I remember giving talks on networks in IBM's future over at Armonk, at the corporate headquarters. I remember Fubini, Gene Fubini, saying: "I simply don't understand why you," and I had a few friends with me, "you guys are so excited about networks, but it you people say it's that important, we'll sure do something about it," and he was then supportive of what we wanted to do about networks, but still he insisted he didn't really see what all the excitement was about, and that was -- IBM was much harder to move than the universities and the not-for-profits, but I did strike a deal with my boss, the Research Director, that I could order a lot of equipment. There was a scope called a 2250, a nice big high-speed scope, and I must have gotten a dozen of those, and a lot of little computers -- 1130's they were -- and tried to get an interactive setup. I ordered them for me, not (unintelligible), my job was to be full time consultant to the Research Director, but by the time they were built and delivered, the lab was enthusiastic enough that there was a taker for each one, and in fact several takers for each one. My main effort in those days, I guess, was promotion. I was being more a promoter than a scientist or a researcher.

Pelkey: Did your impact at that point on IBM lead to their ability to be able to participate fully in this timesharing business when it first started in the late '60s?

Licklider No, what really -- I helped confirm some of it, but I think IBM realized it had made a mistake by telling MIT it didn't want to build a special timesharing computer, so by the time I got there, IBM was setting up a project to build a timesharing operating system called 'TSS', I guess. That turned out really to encounter the troubles of software development. It was very slow. I then turned my efforts to getting IBM to -- I thought, at first, to start up, and then I found out there was the Sub Rosa one in Cambridge to support Norm Rasmussen's system, called -- what on earth was his called? Well, he had a timesharing system that was about one tenth the size of TSS, so it could, in fact, be built and finished, and it turned out that 50 or 100 -- many Rasmussen timesharing systems were sold, and I think only two TSS's, maybe. It was really educational to see. I've seen this several times since, where the entry that wins, in competition, is the smallest and simplest and technically least ambitious one, because it's the only one that in fact gets built and debugged. In speech understanding that was true.

Pelkey: IBM, in terms of data communications, really never -- one could argue SNA, and if one were an IBM bigot you'd argue that they're important -- but in terms of the great tide of changes taking place over the last 20 years, IBM has been more of a participant than a leader in this process.

Licklider I had an office in Project MAC down on the second floor in the latter part of the '60s, or early '70s I guess, and right through the wall from me was an IBM lab. A fellow named Johnson -- I forgot his first name -- and he got interested in networks as ARPA was building the Arpanet, and pretty soon IBM had a little three or four node network, and that developed directly into its present network, which I suspect is the largest one in the world. It's a huge thing. So I would say, in actual internal use of networks, IBM was in there pounding away, but it didn't develop new ideas, new techniques. It rather quickly got to a place where the network was a big physical, ongoing thing that let them, for instance, develop voice-mail, I believe, in a serious way before anybody else had voice-mail. Well, what is this thing they've done in the last six or eight or ten years?

Pelkey: PROFS?

Licklider PROFS, yeah.

Pelkey: When, in the early '60s, before the network came into place, did a group of you, and did you and the people you interacted with, was the concept of electronic mail something that was clearly understood?

Licklider There was electronic mail -- in each timesharing system there was a mail system, so as soon as anything was linked together there was -- I think maybe BBN built the first one, a system called MSG, which was a message system, (unintelligible) a protocol, which really just allowed people to adapt their local timesharing mail systems to a network-wide mail system. That worked pretty well. It was very crude, but it had the essential components. So there was some unhappiness when people started doing experiments and making other systems, because things got worse instead of better. You used to be able to communicate with a lot of people and now you couldn't because they were all using different schemes. I'm not sure there was ever an electronic mail project. It was just the kind of thing that happened. There was an awful lot of independent research. People were not paying too much attention to the fact that -- here goes 30% of the total effort off onto something, and it was all right because it was generating interesting new stuff.

Pelkey: And that was the kind of philosophy or attitude during that period of time too, just to encourage people just to do things. During this period of time, what are your impressions of what the background was like, in terms of the resistance that was out there in the form of AT&T or IBM or the world at large, relative to some of these views. AT&T, with it's circuit oriented view of the world, of what came along, this datagram view of packets, it seemed at some level very natural for the computer scientists to come up with packets, or messages, because that's how operating systems worked; messages as opposed to circuits, but it was a real paradox shift that went on during this period of time.

Licklider I think that's true. I think in ARPA, we were not overly concerned about any counter-pressures or limitations in the outside world, at least when I was there we weren't, because we had plenty on our plate and had a lot of enthusiastic contractors who were doing their thing. I do remember some visits to

the Bell Labs with a feeling that, gee, there's not really very much communication here. I tried to make it clear that ARPA would look with favor on having a contract with Bell Labs. It was a little touchy. You couldn't just come right out and say (unintelligible), but the same thing with Xerox. I went to Xerox and said: "Just to get communication to flow, let's have a little contract," and Xerox never had more than $25,000 a year, or something, but it did make it part of the ARPA circle, and we met a lot of people we wouldn't have met. The telephone company wasn't interested in anything like that.

Pelkey: Why?

Licklider Well, Buick used to have the expression: "When the better cars are built, Buick will build them." I have a feeling the telephone company felt: "When there's a time for networks we'll know about it."

Pelkey: But my understanding that early on they had a local area network; they had things that were half Pearce and Newell and Farmer, those things were happening much earlier there than at other places, but they never went anywhere. Modems are another example; AT&T -- the government went to AT&T and said: "Build modems for us," it was their franchise, and they lost it. Here was this citadel of research and innovation at Bell Labs that became very resistant to outside ideas and influence. They accomplished an immense amount in other fields, but in this field, they were noticeably absent.

Licklider Well, it was clear in the case -- when I was there the second time, we were trying to set up a satellite link with Britain, and to deal with British General Post Office, or whatever that's called, was just a totally different experience to me from anything else. They wanted us to buy insurance covering their whole plant, practically, in case our IMPs set fire, or something, to their equipment. It was really weird. Their worst fear was that somebody in Europe would call up, through some kind of a network, to a British Telephone installation, and get through it into the Atlantic link and get to the United States, and somehow bypass the fifteen cent toll, and, "Christ," I said, "this is just a research and development thing. If we can make it work, if it really turns out to be a great idea, we can figure out about rates and stuff." We wanted to extend an Arpanet link -- we needed in a desperate way to extend the Arpanet link to Stuttgart, and to some American military base down there -- I forget the name of it -- and they would never let us have the one little link. We eventually got there by going through Italy or something. There's a very different attitude toward 'throw the rules out the window and go do something that's possibly interesting and do enough to find out whether it's really interesting' and then if it is, we can worry about rationalizing it. I don't want to get on the side that said the Bell Labs were not creative and innovative.

Pelkey: Nor am I, it's just in this area, they missed the boat.

Licklider One other thing about the telephone company: I was fairly close to the telephone company. Back before I ever got into computers I was in speech and hearing, and I knew Harvey Fletcher quite well. He was the grand old man who got the telephone company into speech and hearing. Even with -- even Harvey Fletcher didn't really see a system that included talkers and listeners. The telephone, that was the object of their research, was a physical system that kind of stopped with the microphone on one end and the earphone on the other. Although Fletcher knew that they had to understand a lot about speech and about hearing, it was just a foreign idea that . . .

Tape Side Ends

Pelkey: . . . you get outside the telephone network into inter- building, like local area networks, that wasn't their world, so they got themselves into a paradigm of --

Licklider Well, they should have made it their world early, because a local area network is a big item in the communication world.

Pelkey: Absolutely. It has overtaken, in terms of economic significance -- the ideas that flowed out of Arpanet have overtaken, economically, the importance of things such as modems and multiplexers, which was 100% of the market at that point. They've missed out on these opportunities, which they should have

participated in. It wasn't that they didn't know about them, at some level. They admit, in retrospect, that they knew about them, but they didn't think that was part of their world.

Licklider Well, you know the telephone company --

Pelkey: (unintelligible) -- that issue of the visionary who puts forth the idea that -- the systems development; you have to develop all of these parts, but the purpose of developing the parts is the end, as opposed to people building a part and getting to think that that's all there is. Coming back, do you remember anything about this Michigan meeting, where the principal investigators got together, and the one where Wesley Clark was credited with coming up with the idea of the IMP?

Licklider Well, I think Wesley came up with the idea of the IMP at a small meeting, maybe 10 or 12 people, in the Pentagon, that Larry or Bob Taylor called. I remember awfully well his talking about the IMP idea, and convincing everybody that that was the way to go. I remember a meeting at Michigan, which was riding piggy- back on some national meeting, but a meeting of ARPA principal investigators, and I think the particular topic for that one was -- a fellow named Calvin Moors and his concept of a reactive typewriter, but I remember he was a little put out because we talked about that for a half hour or something, and then everybody kind of moved on to networks and communication, and it more or less -- the (unintelligible), the reactive typewriter was an accomplished fact -- (unintelligible).

Pelkey: Going back to this issue of energizing people to do things, Bob and Larry both spent a tremendous amount of time -- Bob 'til the time -- less and less and Larry took over more and more the ownership of this concept of getting these other research sites to give this 10 to 15%, and then, even after the first four nodes got up, the process of getting this host-to-host software completed took much longer than anybody expected because one, maybe they had graduate students doing it, but secondly, no one was willing to commit enough energy at these different sites to develop a consensus of how it should be and how it should work in order to get it completed, so I understand. That was a very difficult time until the end of 1971. So, from the end of 1969, during 1970 and 1971, it was really an issue of the host-to-host software.

Licklider I believe part of the dilemma was this discrepancy that I mentioned earlier, between how easy it is to visualize some beautiful big system and how terribly -- and then it was even harder, because a lot of this stuff was being written in assembly language, and people didn't really have a concept of how you make partitions between people or how you make stratifications; a lot of stuff that's just common wisdom now was not understood then. I remember a meeting at MIT of lots of people interested in the network; let's see, Doug Englebart and I were co-chairmen of a group on duo-log and dialogue, how to make systems whereby people would communicate direct -- and we dreamed up stuff that was going to take five years to -- I'm not sure we could even write a report of this thing. We spent all the time at the meeting having ideas and being happy, and then somebody had to settle down and do the work, and I'm not so sure it was reluctance on anybody's part to do it. It was sort of like being at a big smorgasbord where everything is delicious, and people are grabbing this part, this part and that part, and there wasn't anything, except Larry's firm resolve and a little control over the budget, to force people to eat the particular part of the smorgasbord he wanted them to eat, and to systematize it so that something would --

Pelkey: That's a good impression, because it did take a great deal. The whole process of -- another intellectual roots issue, there, is this issue of layered software and networks. Now with the ISO seven layers, people just think naturally that these things should be layered, but when that process started off, there was no -- it became layered, maybe, because people realized that, in terms of managing the project, Larry's perspective was, in terms of managing these projects, you segment them and partition them and keep them separate so that you didn't have one gigantic system, you had multiple small systems.

Licklider Well, the network, in a sense, did enforce a good subdivision. There was the software that was in the IMPs and the TIPs, and they were so small there couldn't be very much there, so the very basic stuff had to be put there. Then you came to all of the service and application support functions that you'd

have to have in order to make it easy for people to do things, and I don't think that's ever been done. The network is still poor and limited in support for things.

Pelkey: Paul Baran refers to it as an experiment that went bad, in that it was just meant to prove that you could connect things together and you could pass things around, and it became so important, largely because of electronic mail, that it stopped becoming an experiment, it became de rigueur --

Licklider Well, the statistics -- if I understand thing right, it came fairly early, like in '73 or '4 or '5, to a point where it was handling as much traffic as AutoDIN was, where AutoDIN was taking from two hours to two days to deliver something, the Arpanet was doing it in two seconds or something, and still people were concerned about priority. I was trying to tell them: "Look, the worst this does is way better than the best that -- [laughter]"

Pelkey: That must have been a fascinating argument.

Licklider Well, we finally did have to establish some kind of priority scheme just --

Pelkey: To keep them happy --

Licklider Yes.

Pelkey: -- so they felt relieved that messages would get through in less than two days.

Licklider But now, I believe the Arpanet has slowed way down. It's a sluggish mess. The last few times I tried to use it, it just was not worth using. It's too bad. That really hurts.

Pelkey: Do you remember anything else from those days that we haven't touched on, relative to communications? To me, the genesis of the idea still comes back to your concept of, at some level, interactive computing, because the concept of multiple people sharing a single resource at a site, that logical extension of those sites being able to share -- this notion of the 'Intergalactic Network,' which I gather was just a phrase you put in an internal paper -- you may have used it in your conversations with people in your going off and preaching to people about this --

Licklider It was a well-known idea at that time that, although a lot of the effort was going into timesharing, it was memory sharing that was really important, it was not fundamentally important to share the processor. At that time, the processor was very expensive and we had to, but I remember that's in papers that several of us wrote back then. We were really trying to get at resource sharing, of memory and what's in memory. Oh, bandwidth. An important aspect of Larry's view of this whole thing was that it was going to be necessary to have pretty high bandwidth, -- that he couldn't really demonstrate what he wanted to demonstrate with narrow band stuff. This led to a thing -- I guess there's no significance to this, but I thought it was funny -- at Ames, where the ILIAC was. They made a special 256 kilobit link into a couple of other parts of the ARPA network so that people would really not suffer any, and that turned out to be so slow that the people at Ames were just totally uninterested in the network. It was just awful. It must have been six months of just fighting back and forth with Ames people and Larry before somebody went and really looked at the thing, and it was electronically wrong and a packet leaving Ames would go to some other place, turn around and come back several hundreds or thousands of times before it would ever get out. It was, in fact, so slow that it - - it was just differences in mind sets were so great that nobody ever wanted to see -- it was really quite a radical change when they fixed whatever was wrong about the logic of the circuit.

Pelkey: If I understand, from other books I've read about that period of time, for you it was really your studying -- what brought you to this idea that became interactive computing -- was looking at how you spent your own time, and realizing that --

Licklider No, I got interested in interactive computing before that. I remember the thing about how I spent my time, but that was done after we had gotten the PDP-1, I think.

Pelkey: Was there any one moment in time when this concept of interactive computing became something that --

Licklider Well, it was implicit in the Sage System. There were, for instance, cloud filters in the Sage System. A cloud would jam the whole business, because the computer, having delivered the cloud, all of the pixels in the picture of the cloud -- so there was a poor guy who sat there was a light gun, which was an old human-engineered light pen that you held like so -- and he would go around all of the clouds, telling the computer: "Don't bother to computing anything in these places." That's a poor example of interactive computing because it's so ridiculous, but it was clear in the Sage System that a lot of what you were doing in the command and control was very closed-loop short time stuff. When I went to ARPA, there was the assumption that we were going to run a command and control project, and it was my conviction that you can't really do command and control with batch processing. So I finally won my point. "Compared to all the money you spend on command and control with batch processing, this is small change. Let's not ask too many questions about it, let's just do it," and I got agreement about that, and we were off and running.

Pelkey: That then caused you to move to IPTO, or did you move before --

Licklider I moved before I convinced anybody.

Pelkey: What caused you to move?

Licklider Jack Ruina gave me a talk -- he was Director of ARPA -- and Gene Fubini gave me a talk -- he was in the Secretary's office -- and they both convinced me that it was just very important for the Defense Department to learn more about computing than it knew, and here was a good chance to do that. I acquainted them with what I was interested in, and they said: "Well, that's interesting. We'll support you in that. Come on down here and we'll put something together," so I had fantastically good support and didn't have to go justify myself constantly, as a lot of people have had to do since.

Pelkey: I have lots of other questions but limited time. Could you, given I've shared with you my vision of where the future it going and you, as much as any man, have thought about this and experienced it in ways I have not experienced it, and few people have experienced it, is this vision of information highways, in that it's going to profoundly change things --

Licklider Well, I remember writing something once about the highway system model of information transfer, and the thing that seemed to me to be interesting was the concept -- one system of things maintains a highway network, and doesn't necessarily run the buses or drive the automobiles. There's a lot of entrepreneurial activity at the next level, and even there you can distinguish three or four levels. Paul Baran was saying essentially that what the country needs is this infrastructure that is really highways and you want to think about the traffic, about the applications in order to make the highways right; you've got to be the right width and the curves have to be gradual enough that you don't run off. That all seems right, but it bumps into the fact that you've got an existing system, and here, for six or eight years, we've had the government philosophy that says the marketplace is what wants to shape how everything goes. I suppose that if I had gone to -- if 1962 were 1982, I would have gotten nowhere trying to promote government experimentation with things. I don't know who's going to do it if government doesn't, unless some big organizations -- IBM or the telephone company or somebody -- decides to do it, but what I see there is that you've got the computer world, with the telephone having a terrible time making any effective entry, and you've got the communication world, with IBM messing about with Rolm and so forth, but really, that's just -- and I don't see anything very promising in this country about how computers and communications are really going to get together. Perestroika is what we need. We need a restructuring of the whole communications machinery, the concept and the physical plant and everything. A company like MCI can get converted over to fiber optic fairly fast, in five years or something, but to get the whole thing converted over, and then it's not clear that optic fiber will be the right thing then. In my view, there

ought to be, instead of running along at a 5% R&D level, they ought to run along at about a 20% R&D level. Look at, in technology, the life span of things is four, five or six years, and in society the life span of things is a couple of generations.

Pelkey: In that regard, we changed ARPA to DARPA. Bell Labs, post divestiture is going to change its charter in terms of research efforts. If you look at big systems projects that have gone on, Sage was profound, in terms of taking a lot of the technology created during the war in information theory and cybernetics and computing, all of that, trying to create a big project of it, which led to a lot. The Arpanet, and a lot of the things that were done at ARPA in the early days; Xerox PARC which -- this issue of research management and how we create these new systems, this new communications process --

Licklider I think an important aspect of the whole thing that is often neglected is the concept of getting a research group well funded, but at the same time, disconnected from the people who want quick results.

Pelkey: Right.

Licklider In Xerox, that was terrible, in some ways, because the disconnection was so profound the rest of the company didn't know what these guys had done. Certainly in my stay at ARPA, it was a plus to me to have good protection -- and then this happened. Bob Sproull --

Pelkey: These days, it's -- this concept of NSF, of funding the individual, if you will, which is funding projects that incorporate multiple disciplines --

Licklider And when they do fund an institution, it's a two-level hierarchy. The institution then funds all its individuals without having a project with a real purpose.

Pelkey: And that's a real impediment to us making progress in some of these systems level problems.

Licklider Maybe that's good, but we need also to have some big engineering projects, and more and more they're engineering with social engineering thrown in along with the technology engineering.

Pelkey: I think it's an important issue. This issue about the paradigm shift -- how people will, and how organizations will, change when people can get connected to other people. I share briefly some of the kinds of views I hold.

Licklider Well, I like what Englebart has written about that, except that he tends to write in a complicated way, and he isn't sufficiently a salesman, but I think he's had the right idea for a long, long time -- or A right idea. I haven't followed too closely what happens in business schools about that, but there ought to be a lot of good writing in business schools.

Pelkey: They don't have first hand experience with it. That's the difficulty; business schools, and businessmen, per se, are really left out of this. The engineering community is the one pushing. Within DEC, or within IBM, where they've created these networks, those environments are changing, but within the general business community, it's like it's happening on the moon.

Licklider Yeah, I've done some consulting with businesses in New York, and everybody will buy a personal computer, but it's very hard even to get them connected together.

Pelkey: Yeah, and they're never turned on, but they have one.

Licklider Well, you tend to get your enthusiasts, and theirs are turned on all the time, but that's 20% or 10% of the population.

Pelkey: Mindful of your time -- I don't mean to hold you -- but is there any other area, in terms of my looking at this communications and what you see as an important --

Licklider There's a lot of stuff that sort of never did happen. Multi-media communication -- people in desktop publishing are coming to grips with color and mixing of images of various sorts with text, and tables of data, and all of that. Things are progressing, but the computer communication confluence seems to me not to be happening in a way that will support, so that if, in fact, you want to send something someplace -- I have, for instance, a graphical programming system, where you draw and control boxes on the screen and put together a program, and I want to send that to somebody to show it to them, or let them use it remotely -- this is prohibitively difficult. We never did develop the supports for the other media, other than text. Maybe (unintelligible) text and data. If you can figure out how to restructure things in the United States so that things like that will happen, you'll be a hero in my eyes, but it's very difficult --

Pelkey: It is difficult, I agree.

Licklider -- and I think what you're electing to do here is say: "Well, one medium is to write clearly and in an expository way and an enthusiastic way about this sort of thing, and some people will read that and be influenced." Once in a while in history, a book is really a dominant force in shaping what happens, as we may think.

Pelkey: I don't have those designs, but I hope I can get some of this on paper. Thank you for your time.

INTERVIEW ENDS