SCIENCE HISTORY INSTITUTE

SAM ELETR

Life Sciences Foundation

Transcript of an Interview
Conducted by

Mark Jones

at

Burrill & Co.
San Francisco, California and Kensington, California

on

15 February 2012 and 15 May 2014

(With Subsequent Corrections and Additions)

CHEMICAL HERITAGE FOUNDATION
Center for Oral History
FINAL RELEASE FORM

This document governs access to the audio- and/or video-recorded interview conducted by Mark Jones on 15 February 2012 and 15 May 2014 with Sam Eletr. The interviewee elected not to return the original transcript supplied by the Chemical Heritage Foundation within the agreed-upon timeframe for review.

1. The recordings, transcripts, photographs, research materials, and memorabilia (collectively called the "Work") will be maintained by the Chemical Heritage Foundation and made available in accordance with general policies for research and other scholarly purposes.

2. The Chemical Heritage Foundation maintains all right, title, and interest in the Work, including the literary rights and the copyright in perpetuity.

3. The manuscript may be read and the recording(s) heard/viewed by scholars approved by the Chemical Heritage Foundation.

Signed release form is on file at the Science History Institute

(Signature) _____
David J. Caruso, DIRECTOR, CENTER for ORAL HISTORY

(Date) 2/26/18

OPTIONAL: The following restrictions are in place on the use of this interview:

_____

_____

Regardless of any restrictions that may be placed on the transcript of the interview, the Chemical Heritage Foundation retains the rights to all materials generated about the oral history interview, including the title page, abstract, table of contents, chronology, index, et cetera (collectively called the "Front Matter and Index"), all of which will be made available on the Chemical Heritage Foundation's website. Should the Chemical Heritage Foundation wish to post to the Internet the content of the oral history interview, that is, direct quotations, audio clips, video clips, or other material from the oral history recordings or the transcription of the recordings, the Chemical Heritage Foundation will be bound by the restrictions for use placed on the Work as detailed above. Should the Chemical Heritage Foundation wish to post to the Internet the entire oral history interview during the interviewee's lifetime, he or she will have the opportunity to permit or deny this posting.

The Chemical Heritage Foundation will enforce the above restrictions for a period of five years, after which any restrictions will be removed.

This oral history is designated **Free Access**.

Science History Institute

Chemistry • Engineering • Life Sciences

The Science History Institute collects and shares the stories of innovators and of discoveries that shape our lives. We preserve and interpret the history of chemistry, chemical engineering, and the life sciences. Headquartered in Philadelphia, with offices in California and Europe, the Institute houses an archive and a library for historians and researchers, a fellowship program for visiting scholars from around the globe, a community of researchers who examine historical and contemporary issues, and an acclaimed museum that is free and open to the public. For more information visit sciencehistory.org.

SAM ELETR

1939	Born in Alexandria, Egypt, on 24 March
2024	Died in San Francisco, California, on 15 May

Education

1959	MS, Polytechnic Institute, Electrical Engineering
1968	PhD, University of California, Berkeley, Physics

Professional Experience

	Centre de Recherche Paul Pascal
1969-1970	Visiting Professor
	University of California, San Francisco, School of Medicine
1970-1972	Member, Cardiovascular Research Institute
	Hewlett-Packard Corporate Research Laboratories
1973-1979	Manager of Analytical and Medical Instrument Group
	Applied Biosystems Incorporated
1979-1987	Chief Executive Officer
	Lynx Therapeutics
1992-1999	Chairman of the Board
	iStat Corporation
2001-2003	Director
	Solexa Limited
2002-2004	Director
	Third Wave Technologies Incorporated
2002	Director
	Domain Therapeutics SA
2008-2014	Chairman
	Rhythm Diagnostic Systems, Incorporated
2017	Chairman

ABSTRACT

Sam Eletr begins his oral history interview discussing other scientists and the origin of Applied Biosystems before starting to talk about his life. After getting his PhD at the University of California, Berkeley, Eletr returned to France where he worked as a postdoc for two years. He decided to return to the United States after the postdoc concluded because he wanted more academic freedom. For two years, he worked in the laboratory of Manuel F. Morales in the School of Medicine at University of California, San Francisco, and gained experience with computers there, which prompted his interest in working at Hewlett-Packard. When he first applied to Hewlett-Packard, he was rejected by the personnel department. Undeterred, Eletr wrote a letter to William R. Hewlett, who invited him to meet with Dean Morton, the head of the medical division, who offered Eletr a job. Given his past experience, Eletr received "wet stuff" for review from other departments. One day he received a proposal for a protein sequencer, his first introduction to the tool. But when he asked those higher up in the company about it, they thought it was "too wet" for Hewlett-Packard. The sequencer did not leave Eletr's mind. Several venture capitalists reached out to him, and he finally decided to leave Hewlett-Packard to promote development of the protein sequencer. With contributions from five venture capitalists, he founded Applied Biosystems (initially Genetic Systems Company, or GeneCo).

In his interview, Eletr talks about the early stages of Applied Biosystems, including mentioning initial employees like André Marion and working with scientists like Leroy E. Hood. After serving as as CEO, chairman of the board, and head of research for three years, Eletr hired Michael W. Hunkapiller to replace him as head of research just before the company went public. Eletr mentions the rationale for locating the company in Hayward, California; its initial business plan of developing four instruments (protein sequencer, DNA synthesizer, peptide synthesizer, and DNA sequencer); and the process to acquire licenses for the valves used in the machines. He talks about first meeting Nobel laureate Sydney Brenner and establishing a decades-long working relationship with him. Although Eletr briefly mentions all four instruments, he discusses the DNA sequencer in greatest detail. He also discusses his experience interacting with board members. By 1987, Eletr found himself too tired to maintain the extensive travel required as CEO of Applied Biosystems, so he decided to resign. After a several-year hiatus, he returned to the company as a consultant and created Lynx Therapeutics as a spin-off company with Brenner, which Eletr discusses in the interview, including Lynx's combination with Solexa to form Illumina Sequencing. Eletr also mentions his involvement in other companies after Lynx, including Population Genetics (also with Brenner) and Andrew Alliance. The interview concludes with reflections on the human genome and thoughts about various scientists and venture capitalists.

INTERVIEWER

Mark Jones holds a PhD in history, philosophy, and social studies of science from the University of California, San Diego. He is the former director of research at the Life Sciences Foundation and executive editor of LSF Magazine. He has served in numerous academic posts and is completing the definitive account of the origins of the biotechnology industry, entitled *Translating Life*, for Harvard University Press.

ABOUT THIS TRANSCRIPT

Staff of the Life Sciences Foundation conducted this interview, which became a part of our collections upon the merger of the Chemical Heritage Foundation and the Life Sciences Foundation into the Science History Institute in 2018. The Center for Oral History at the Science History Institute edited and formatted this transcript to match our style guide, but, as noted, Science History Institute staff members did not conduct the interview.

The Center for Oral History, Science History Institute, is committed both to preserving the recording of each oral history interview in our collection and to enhancing research use of the interviews by preparing carefully edited transcripts of those recordings. The preparation of interview transcripts begins with the creation of a verbatim typescript of the recording and proceeds through review and editing by staff of the Center; interviewees also review the typescript and can request additions, deletions, or that sections be sealed for specified periods of time. The Center keeps track of all changes that staff, interviewers, and interviewees make to the original typescript. Please contact us if you would like additional information about these materials. We have established guidelines to help us maintain fidelity to the language and meaning of each recorded interview while making minor editorial adjustments for clarity and readability. The transcript also includes time stamps at five-minute intervals. We omit without noting most instances of verbal crutches and all instances of nonlexical utterances. We also make small grammatical corrections where necessary to communicate interview participants' meaning. Finally, staff of the Center create the abstract, chronology, and table of contents. With the availability of online full-text searching of our transcripts, the Center for Oral History opted to discontinue the practice of preparing a back-of-the-book index for each oral history transcript in 2020. **The Science History Institute is committed to the responsible presentation of the history of science by addressing evidence of inequality and oppression as well as the subsequent silences in our collections. To that end, we recognize there may be language in our oral history collection that is outdated, offensive, or harmful, such as, but not limited to, the following: racist, sexist, Eurocentric, ableist, and/or homophobic language or depictions.**

TABLE OF CONTENTS

“Bill” Rutter. Joining the board of Solexa. Creation of Illumina Sequencing. Deciding to pursue other ventures. Regular travel. Population Genetics. SpinX. Reflections on American society contrasted with other societies in the world. Reflections on the human genome. Focus on infectious diseases for Population Genetics. Mike Hunkapiller. Bill Efcavitch. Reflections on interactions with venture capitalists of the past contrasted with venture capitalists of today.

INTERVIEWEE: **Sam Eletr**

INTERVIEWER: **Mark Jones**

LOCATION: **Burrill & Co.**
San Francisco, California

DATE: **15 February 2012**

JONES: How do you spell that?

ELETR: Cheryl? I think it's Heiner, and Cheryl right now until recently she was at Beckman [Coulter Incorporated] Bio. She had left Applied [Biosystems Incorporated] and gone to work at Beck Bio and I heard—I'm not quite sure—I heard it mentioned that she just left Beckman Bio to go somewhere else, so you may be able to track her through Beckman Bio.

JONES: Yeah, yeah, okay, very good.

ELETR: She was the one who had brought to my attention, to our attention, the difficulty of pursuing the path that had been explored in Leroy [E. Hood]'s laboratory in terms of doing the gels in capillary columns.[1] This idea was to develop the device that would have as many capillary columns as one could accommodate in the optics, which hadn't been designed really, and we found that it was not possible to pre-fill capillaries with gels, leave them on the shelf, and ship them customers. They deteriorated. She brought that to our attention after . . . . I think the machine would have probably come out a year or two earlier if we had not abandoned that particular flawed design from the beginning.

Anyway, when she brought it to our attention, we made a stop to the development and went to the flat plates, the electrophoretic plate, and designed an instrument that was able to optically read the flat plate as opposed to one we had started to design to read the optical gels. I think Mike [Michael W.] Hunkapiller remembers this incident well, of the decision process well. Cheryl was involved in that, and she was a key to the development, I think. Interested to . . .

JONES: I'll try to talk to her. We did talk with Paul [D.] Grossman.

[1] Leroy Hood, interview by David C. Brock, Arnold Thackray, Arthur Daemmrich, Ted Everson, and Mark Jones at New Orleans, Louisiana, Seattle, Washington, and Institute for Systems Biology, Seattle, Washington on 19 March 2002, 27 April 2006, 25 March 2012 (Philadelphia: Science History Institute, Oral History Transcript # 0243, in process).

ELETR: Paul was not yet at Applied Bio.

JONES: Right, yeah, he was much later, he was doing.

ELETR: My history with Paul Grossman goes back to when he was eleven years old. [laughter]

JONES: And the Berkeley marina.

ELETR: Exactly. But I think his first summer job was at Applied Bio because of the Berkeley marina in part and then later he worked at Applied Bio, took a leave from Applied Bio to get his doctorate, got his doctorate, came back, and he was involved in the development of the next-generation capillary electrophoresis sequencing.

JONES: Right, he told us about that, but that's another step.

ELETR: Yeah, that's another later history. Now, the one thing that's important to note which in my interactions with various people who come and ask me about my history and the history of the company is that Applied Biosystems [Incorporated] did not start to develop a DNA [deoxyribonucleic acid]-sequencer. The first product was a protein sequencer and had we not developed the protein sequencer and developed the devolving mechanics of handling all the reagents that would need for the protein sequencer. The DNA sequencer probably would not have been developed in that form. Obviously, somebody else . . . it's one of the things, people say, "You're the first to develop it." Well, if I hadn't done it, someone else would have done it so I can't take much credit for it. [laughter]

JONES: Well, but it's important the way things do in fact unfold.

ELETR: We started with developing a protein sequencer and the irony of it all is that I was trained as a physicist and when I first heard that people sequenced proteins, I go, "Sequence protein? What do you mean?" I had to go to the library to find out what it meant to sequence a protein. A year later or a year-and-a-half later, we put out on the market the protein sequencer, so I just happened to be there when that whole thing happened, so . . .

JONES: Can we start at that and make this a biography and start at the very beginning?

ELETR: The very beginning, **<T: 05 min>** I was working at Hewlett-Packard [Company].

JONES: No, I mean the very beginning where you were born, I assume you have—

ELETR: No, no, I don't want to get into that.

JONES: You don't want to?

ELETR: No, and I'll tell you why. I mean, it's not that I don't want to do it. It's that I'm just about to finish a book which retraces my path in the context of my encounter with Silicon Valley. I don't want to do that.

JONES: Sure, no, that's fine. So . . .

ELETR: When do you plan on finishing your history?

JONES: We've got December 2013 for the first volume of the history of biotechnology, and we're looking at a five-year period from 1976, if you want to maybe look . . . to . . .

ELETR: It may very well be that in three to six months I'd ask you to read a manuscript if you'd like so—

JONES: I'm very happy to do that, sure.

ELETR: You might learn something from it as well as help me correct a few things.

JONES: Yes, I'm happy to do that. That'd be great.

ELETR: Let me start with the beginning of Applied Bio.

JONES: Okay, well, maybe can we start with just briefly how you got into Hewlett-Packard and what you were doing there, getting into—

ELETR: Yeah, sure. I got my PhD in Berkeley. After getting my PhD in Berkeley, I went back to France where I had done my undergraduate work with the idea of never coming back to the United States, not because I hated it, though, or anything but just that I came here to study and I wanted to go back to France. I went back to France on a postdoc and after two years of working in France, I decided that one had a little bit more freedom to do what one wanted in the context of American industry or academia.

JONES: Is that right?

ELETR: Yes. When I went to France, I was very much interested in working in applying the physics. My training in physics was in spectroscopy; I got my PhD in biophysical spectroscopy, if you will, at Berkeley. My original training in France and then at Berkeley was basically in the hard sciences, in the physical sciences. I got interested in wanting to apply the physical tools that I had learned to the biological arena, without knowing exactly what that meant, okay?

JONES: How did you develop that interest in biology? You're trained in physics. How did you move in that direction? Was it—

ELETR: Well,

JONES: . . . mentors or . . .

ELETR: It's one of those things I'm still in the process of exploring and trying to understand. I think a key element of it was when I was in high school and [James D.] Watson and [Francis] Crick came up with the double-helix thing. Crick was a physicist. I found it interesting that a physicist was. I had gone into physics simply because in the French educational system you go into the things where you have the best grades. I had the best grades in physics so I went into physics. While I was doing my doctoral thesis in Berkeley what I was doing is magnetic resonance was the spectroscopy that I used. There were some people who were starting to use magnetic resonance to look at biological systems and I thought that might be interesting.

Then one day another physicist came to do a lecture in Berkeley Physics Department and that was . . . his name escapes me right now. My memory is beginning to fail me in some detail. I can fill in the names later. He was the inventor of, the discoverer of the properties of liquid

crystals, [Pierre-Gilles] de Gennes. I thought, "Well, this is interesting. The guy's working in liquid crystals." I looked at liquid crystals. I made up cholesterol **<T: 10 min>** molecules at the time and it's what he used. What does cholesterol do? Well, cholesterol is involved in the structure of cellular membranes and is involved in cellular membranes and I'm thinking in my mind about whether one could study the structure of cellular membranes by magnetic resonance. It was . . . anyway.

JONES: And nobody had done that?

ELETR: I wouldn't make that statement. I don't know.

JONES: But you didn't know then either?

ELETR: I didn't know then either and I don't know now if people have done it then because I had never been the kind of person who goes in the library and study things to death. I've always—and in the context of Applied Biosystems and later—I've learned there are people can do that much better than I can. I better ask them to do it for me or ask them what they have learned of the various topics. It takes me fifteen minutes to get the results of two hours of research. I'm intrinsically lazy. **[**laughter] Anyway when I got my postdoc in France, it was in the laboratory of someone who headed a National Research Council Laboratory in France, who had come to visit with Professor Melvin Klein—not Melvin. Melvin Klein was the head of the lab at the time, but it was the lab of the guy who got the Nobel Prize for the—

JONES: Was it in Klein's lab or in Klein's department?

ELETR: No, no, no, no, Melvin Klein was a senior scientist who ran the lab for . . . come on.

JONES: We can look it up.

ELETR: No, no, you see those bumps there on my head? [laughter] No, no, I had a cerebral accident about ten years ago and chunks of my memory or my ability to remember disappeared in that context so I have difficulty. Who was the discoverer of photosynthesis? He got the Nobel Prize for photosynthesis? [Melvin E.] Calvin something. [. . .]

JONES: We'll look this up, take notes, and we will—

ELETR: No, no, he was at Berkeley and there's a round building behind the chemistry department at Berkeley that was built for him, for his work.

JONES: Was it [George C.] Pimentel?

ELETR: No, not Pimentel.

JONES: That's the round building.

ELETR: No, no, Pimentel started running the round building after what's-his-name died. [laughter] What's his name? [laughter] So anyway, what's his name?

JONES: We've got enough clues; we'll figure it out.

ELETR: He came to visit that laboratory—I had nothing to do with the laboratory at the time—and he did not speak English so he wanted an interpreter who knew the field, who could at least translate some of the spectroscopy aspect. They came to me, they said, "Professor so-and-so is visiting the laboratory of so-and-so. Would you come and talk to him?" I went and talked to him and he was interested in the work I was doing and the work I was doing at the time was something to do with magnetic resonance and tying a magnetic resonance machine to one of the first personal computers—not personal computers—mini computers that had come out, the PDP8 Digital Equipment Corporation [DEC].

He came to my lab to meet me, and we chatted for a while. I walked with him to where he wanted to visit and interpreted for him. I came back to my lab and he said, "How would you like to come and do that in France?"

I said, "Do what?"

He said, "I would like very much for this technology to be in my laboratory in France, tying a computer to a **<T: 15 min>** magnetic resonance machine."

I said, "Yeah, sure, I'd like to." Two weeks later I got a check in the mail for the amount I had told him it cost to put buy machines there and he sent me check for—I can't remember now—something to the order of seventy-two hundred thousand dollars. I don't remember exactly—a lot of money at the time—asking me to buy whatever was needed and ship it to France, and the check was signed by his name in France.

Then and probably still now, the heads of laboratory have the signature on the money that's allocated to the laboratory, they have an apartment on the top floor of the laboratory. The whole thing is there. I went to do a postdoc there . . . and I went on to do a postdoc there; we published papers on tying computers to a magnetic resonance machine. As a matter of fact, the paper we published was probably the second paper ever to be published on a particular way to fully transform NMR. I think our paper came out a few months after a group on the East Coast of either Harvard [University] or MIT [Massachusetts Institute of Technology] had published something similar. Because of the interest that had been germinating in my mind about looking at biological membranes, I wanted to do that after having . . . and they looked at me and went, "Monsieur, you are a physicist; stick to physics." That's France.

After I while I decided, well, probably I'm better off going back to California, and that was towards the end of the Vietnam War in '68, '69, and the guy who had hired me, who was happy with the work I had done in France, told me, "You're going to go back to America right now? People are being laid off, end of the Vietnam War, the economy is down."

I said, "Look, right now I feel like I'm better off living on food stamps in California than being tenured in Paris." [laughter] And . . .

JONES: Having that was important to you to have that freedom to do what you wanted to do?

ELETR: Don't make it sound any more pompous than it really is. No, but really, I mean it depends how you say it. I just came back; I wanted to come back. I didn't like the idea of being constrained and confined. Right now, I have three companies in Europe that I either cofounded, or I'm chairman of the board of the three companies. I'm having the same, encountering the same kind of boxing of things. Things have changed but not as much as I'd like.

JONES: Yeah, that's interesting. I mean we need to—

ELETR: Things are within a hierarchy.

JONES: Yeah, so far, the story we've been telling is pretty US-centric, but we need to globalize it and so there's cultural kinds of elements.

ELETR: There could be another chapter, another element there; I'd be happy to talk to you about it.

JONES: I want to ask. You were working with magnetic resonance and trying to computerize this and—

ELETR: Trying to tie a magnetic resonance machine to a computer and look at—yeah.

JONES: So you were paying attention to developments in computing at the time, pretty new.

ELETR: I wasn't really delving that deeply into it. I was making use of what people had done. I've never invented anything in my life. Although I've been involved with a lot of development. It's just that whatever involvement I have had or contribution I have made was to see something over here that somebody knows and something over here that somebody else knows, and see if you took the two things together, something else might come out.

JONES: That's a good description of invention.

ELETR: Well, yeah, but—

JONES: Yes, no, I understand, sure. **<T: 20 min>** So you came back?

ELETR: I came back and I came back and, to give you the contrast between America and France at the time, I came back and my two years in France were well-remunerated. I had enough savings to exist for a year if needed, and I started to say, "Okay, what am I going to do? I really would like to look at this." I started making the rounds of big names or publications at UCSF [University of California, San Francisco], at Berkeley, and I made some connections. I ran into someone in UCSF, who was interested in a particular class of cells. I pointed out to him that . . . before pointing it out to him I looked at some papers and stuff that had been published, and those cells were interested because the cell walls had embedded in it a protein that regulated the transport of things from outside the cell to inside the cell, the release of calcium.

I went to him and I said, "I think some techniques of paramagnetic resonance—not nuclear magnetic resonance—but paramagnetic resonance could be useful in studying that particular mechanism in cells. Are you interested?"

I talked to him for about an hour or so; it was in the School of Medicine. He listened to me, and he said, "I have no idea what you're talking about but if you can interest a granting agency of funding this work, I would be happy to welcome you in my laboratory. Until then, you can use this list, you can use my letterhead, you can use the key to the library, and if you submit an application for a grant, I'll support it."

I did. A few months later, I got a grant from the National Institute of General Medical Sciences to do some paramagnetic work, paramagnetic resonance work, and at the same time, I found someone at Berkeley in the Department of Genetics, who was interested in the same cell system and who was culturing these cells. And I interested him in it.

JONES: What were the names at UCSF?

ELETR: They're long gone. Yeah, it was the laboratory of Manuel [F.] Morales, was his name.

JONES: Manuel Morales, and at Berkeley?

ELETR: At Berkeley . . . . I can't remember that now.

JONES: It's okay, and when you came back to the US, you knew you were coming here to the Bay Area?

ELETR: Yeah, I came back to Berkeley because I knew Berkeley. I had spent seven years doing a PhD there.

JONES: And you thought that there was as much science that you would find people that might be receptive to your ideas here as well as anywhere else?

ELETR: No, no, this was the area that I knew and there was no point in me going to MIT or Harvard or [wherever]. I knew nobody there, so I got the grant through the laboratory—the Manuel Laboratory—and I was made a fellow of the Cardiovascular Research Institute. If you go in to look at the Cardiovascular Research Institute, you'll find my name there. I have nothing to do with the cardiovascular work, but Manuel Morales was working on things having to do with heart muscle counteractivity. I think he got me that just to—

JONES: Yeah, it didn't cost him anything and maybe you come up with something.

ELETR: Yeah, it didn't cost him. I was there for the two years **<T: 25 min>** and after that I was . . . . I began to see the limits of the work that I was doing. I wasn't an MD, there was no possibility of me getting a full-time job, and anyway, one day—

JONES: I'm just curious, did you live anywhere near your—

ELETR: I lived in Berkeley; I lived in Berkeley.

JONES: You were in Berkeley, yeah, okay.

ELETR: I lived in Berkeley and I worked at two places; I worked at UCSF, in the lab at UCSF, and in the lab there was a collaborator of Morales was working in the University of Pacific School of Dentistry. I spent some time in that guy's lab also. I commuted between the two; they were working together. For me it was not a satisfactory arrangement—I was basically a glorified technician if you will. You know the culture of the medical school. There came an opportunity for me to go work at Hewlett-Packard because they were . . . . I had in my work used a lot of Hewlett-Packard equipment, and I've used a computer that I bought for the French laboratory. It was one of the first Hewlett-Packard mini-computer. I said, "I'll try to work at Hewlett-Packard."

I sent them a letter one day and got a nice letter back saying, "Your credentials are impressive" and stuff like that. "But we don't have any room for anyone with those credentials right now." I said, "This is ridiculous." I sat down and sent a letter to Bill [William R.] Hewlett telling him that I received this letter from his personnel department and I just thought they really hadn't looked at the resume. Two or three days later I got a communication—I can't remember if it's a letter or a phone call—a communication from his secretary saying that the Head of the Medical Division of Hewlett-Packard in Boston, [Massachusetts], is going to be here next week, he would like to meet you. "Mr. Hewlett would like you to meet him," or something like that.

JONES: That was a big event, them sending that letter, a big decision, yeah.

ELETR: Yeah, and so I went and I met with, it turned out it was Dean [O.] Morton, who eventually many years later succeeded Mr. Hewlett as the head of the company. I met with Dean, Dean Morton who headed the medical division at Hewlett-Packard who was on the East Coast, and not many people today remember that Hewlett-Packard was one of the leading suppliers of medical equipment at the time.

JONES: What kinds of things were they developing?

ELETR: I'll give you a couple of examples. The best stethoscope on the market at the time was a Hewlett-Packard stethoscope. Any doctor that I saw, if he didn't have a Hewlett-Packard stethoscope, it meant his judgment of quality was not good enough. Anyway, and so it was a snob appeal at the same time. Other types of equipment at Hewlett-Packard were electrocardiograms. If you go in a hospital today to have a cardiogram taken, if it's over twenty years old it will be a Hewlett-Packard one. If it's not over twenty years old, it will be a Philips one because [Koninklijke] Philips [NV] acquired the medical division of Hewlett-Packard some years back.

They were doing a lot of monitoring of electrocardiogram, and they wanted to get into the monitoring of other things. What Dean Morton arranged for me was to see the head of a laboratory at the corporate labs of Hewlett-Packard because **<T: 30 min>** he didn't think that my going to Boston. In Boston what they did is designed a finished instrument that were developed at the corporate labs in Palo Alto, [California]. He introduced me to the head of one of the labs in Palo Alto and at that time that lab had been entrusted by Bill Hewlett to develop a non-invasive blood monitor for pH [potential of hydrogen], PO^2 [partial pressure of oxygen], and PCO^2 [partial pressure of carbon dioxide]. They were in the process of developing an ear oximeter, which was a device that . . . today when you go to the hospital they put something on your finger and that something on your finger looks at the oxygenation of your blood and measures the pulse rate at the same time.

That's the simpler heir to the first device that was developed on the ear to look at the color of the blood without having to take blood out. The difficulty at the time was to look at the color of the blood without taking the blood out was interfered with by the color of the skin. We wanted to be able to take a Black person's skin or a Chinese person's skin. They had figured that the ear being so well profused with blood, there's usually much more blood in your ear than there is in your fingertips and so on and so forth. A device that looked through the skin at the ear and they developed some software or some analytical software—it wasn't computerized—but analytical software to look at the color of the blood and subtract the color of the skin.

It was very complicated but for many years, it was a very successful instrument. Until somebody else had the bright idea of saying, "If I want to look at the color of the blood, if I can synchronize that with the pulse then any variation in the colored spectrum that varies with the pulse would not be the skin because the skin color does not change with your pulse." What changes is the color of the blood. That's why now you have a very cheap finger. At the time this was in '73.

JONES: Yeah, was that HP who did the finger or somebody else?

ELETR: That came later. I think that finger thing came after I left HP so I don't know when it came to HP or anywhere else. I was peripherally involved in that ear thing but in that department I started working on measuring PO^2 oxygen pressure, carbon dioxide pressure, and pH acidity, of the blood.

JONES: This is some distance away from looking at cell membranes?

ELETR: Totally, it's back to spectroscopy. Working on cell membrane, I was sort of on the periphery of what was interesting simply because I was used as a technician by people who are interested in the medical applications of stuff but I couldn't be close enough. I decided to go back to what I was really good at which was spectroscopy, and that's why I wrote the letter to you. I worked on that, developed several instruments. I eventually became head of a section at Hewlett-Packard that was called Analytical and Medical Instruments in the research laboratory. It was a small group. I'm not glorifying it or anything like this—I've just never had more than twenty people. We developed a number of things and part of that development took me back to the medical profession if you will, by getting to test some of those instruments in the surgical room during a cardiac operation on patients who had been opened up and whose blood needed to be monitored for oxygen or for PO2 or PCO2.

I worked at that for a little while. I was at Hewlett-Packard and one day, because at Hewlett-Packard **<T: 35 min>** I was one of the few people there who, even though they were trained in the physical sciences like most of the Hewlett Packard people at the time, I had also dabbled in wet stuff. [laughter] Okay, so whenever something came and was sent to any of the departments at Hewlett-Packard that involved wet stuff, it was sent to me to evaluate. Because of this—that's why I'm telling you all of this—one day he came and confronted me for some laboratory at Caltech [California Institute of Technology] run by somebody called Leroy something or another was offering a license to a modification that they had invented of a protein sequencer made by Beckman. I said, "Oh, what sequences protein? What does that mean?"

I went to the library, looked at it. No more than an hour. I never spent more than an hour in the library, but I found a couple of papers to see what was involved in doing this. I thought it might be interesting because at the time, in the group in which I was working they were also working on a spectrophotometer. As a matter of fact at the time, it was one of the first spectrophotometers; it was the diode-ray spectrophotometer, a solid-state spectrophotometer. I said, "The protein sequencer needs a spectrophotometer of some type to analyze the result of the biochemical reactions. The protein sequencer removes the amino acids one at a time and when you remove an amino acid from the chain, you want to identify it, so you identify it by spectrophotometer."

I went to my boss. I said, "It looks interesting."

He said, "That's too wet for us. That's too far from what we want to do."

I went over his head to the vice president of research, who was also a physicist, and I told him and he said, "No, that's too wet for us." I returned the letter that came to my desk saying that might not be interested in that and then I mentioned that to a colleague or a friend; I can't remember to whom.

He said, “That looks interesting.”

I said, “No, I think I’m just going to say we’re not interested in it.” Then out of the blue I was called by a venture capitalist and—

JONES: Is this Bill [William K.] Bowes [Jr.]?

ELETR: No.

JONES: No, somebody else?

ELETR: Somebody else.

JONES: For something different?

ELETR: I was called by a venture capitalist who didn’t reach me on the phone; he reached my secretary and left me a message, and I thought he was a headhunter. Because at Hewlett-Packard if you were head of the laboratory, headhunters would call you and say, “Somebody else is looking for a VP of research,” Or “A small company is looking for this or that,” and I always sent these away. Working at Hewlett-Packard, it was the greatest place I’ve ever worked at until Applied Biosystems, and I was not interested—sorry.

JONES: Could you say a little bit more about working at Hewlett-Packard—what you really enjoyed about it?

ELETR: I think it was the fact that it was not run by managers. It was run by Hewlett and Packard and by people whom they selected who, based on their competence in what they did, were the ones who managed. There were not MBA [master of business administration]. I remember my first day at Hewlett-Packard. I was shown around in the laboratory where I was going to be joining and came in front of a table. There was a table and that table had two electronic calculators—that was in ’73—two **<T: 40 min>** big electronic calculators, tabletop calculators. These were the only ones in the laboratory and if you wanted to do calculations you went and sat down at that table, you did it, and when somebody wanted to do they came and stood behind you and waited until you finished your calculation to go and do it.

One day I went and I stood behind this thing, and I was stood behind the guy—I was number two in the line—and then an old man came to stand behind me and I didn't know who he was because even though I had written him a letter, I had never met him. He had sent me to Dean Morton. The person in front of me says, "Hey, do you know who is that behind you?"

I said, no, and he said, "It's Bill." I turned around and I said, "Please, you can—"

"No, no, no, it's all right. What I know is that it's not important, just that my calculator has broken down. I'll wait." That's the kind of person he was. It was obvious in the meetings when he reviewed a project, etc., that he really knew what he wanted, what he didn't want. He asserted himself but always in a manner that didn't make you feel small in any way. You knew that he obviously and evidently and all that was better than you in what he did but it didn't strike you in any way as being . . . it was so obvious that it didn't bother you. Because you didn't use it for anything.

And so was [David] Packard also, the project reviews and so on. The atmosphere at Hewlett-Packard was one in which you were trusted to do your job. If you came in early, you came in late, it didn't matter; you could come and go. Another thing too. I had a project review, if I remember it was two or three years into the company. I was very proud that the small group that I was managing had successfully met a number of milestones on the three or four projects that we were working on. David Packard went back, looked at these things, and he said, "There's only one thing wrong here."

I said, "What's that?"

He said, "You don't have a project that has failed which means that maybe you're not pushing hard enough towards new stuff."

JONES: Interesting, yeah.

ELETR: "Don't always take the safe approach."

JONES: There's not too many places that would encourage you to fail. [laughter]

ELETR: It wasn't he was encouraging me to fail but he was encouraging me to reach out. To reach out and don't be afraid to fail if . . . . I could talk for hours on that.

JONES: Did you have a sense being at Hewlett-Packard and being in Silicon Valley that there's really something going on here, the future's being invented here? Did you have that sense that this is a special place? That this is the place to be, you know? [laughter]

ELETR: No.

JONES: No, okay. Yeah.

ELETR: In spite of the meeting I had brought together in that room all of the creators of the whole thing, and I don't think it is as special a place as people want to make it out. Although there's no question that it has a lot to offer. But let me qualify this. I think for the junior scientist that I was at the time, what mattered the more is to find a place where you had the possibility of enjoying your work rather than feeling importance from the world. It's much easier for me today to say maybe I have contributed something to the biotechnology arena and so on and so forth, but I have never wanted to get to the point of doing that.

JONES: Sure, no, I understand. **<T: 45 min>**

ELETR: I don't know if I'm explaining myself.

JONES: Yeah, no, perfectly. Yeah, no, I understand it. So it is very much about doing this task and then the next one and making progress?

ELETR: Enjoying it and enjoying working with the people you're working with and so on. Anyway, where were we?

JONES: You had been contacted by a venture capitalist?

ELETR: Yeah, so I had been contacted by the . . . . I didn't know he was a venture capitalist, I thought he was a headhunter. It got to the point where my colleagues in the lab, my secretary, started begging me to please stop going because he kept calling and calling trying to reach me. He'd leave a message with anybody to reach me. They said, "Please meet him, get rid of him so he doesn't call anymore." I met him and I found out that the reason he wanted to talk to me was because he wanted to start a diagnostic company developing new diagnostic instruments that would leverage half of the genetic engineering revolution that was beginning to happen, okay?

I said, 'What's that got to do with me?" That was the time when the [Herbert W.] Boyer [Stanley N.] Cohen thing had been advertised, when Genentech [Incorporated] was being created.[2]

He was saying, "This gene splicing is going to create a lot of opportunities for new diagnostics and me and my partners want to be able to create a diagnostic company to take advantage of it."

I said, "Fine, but I never invented anything in diagnostics. I don't know anything about diagnostics, and I really don't have the time to go to the library to learn about diagnostics just for you."

He said, "No, no, that's all right. I think you have the stuff in you."

I said, "What do you know about me?"

He said, "Well . . ." It turns out that someone had sent to Hewlett-Packard a proposal for a diagnostic process that had come to my desk as wet things usually did, and I had looked at it, and I decided that it didn't really make any sense, it wasn't going to work, and it had come to me through its inventor. I agreed to see the inventor, met with him; he described to me what he wanted to do. I decided that what he wanted to do really didn't make any sense. I told him so and I told him I'm not interested. He went back to his venture capitalists to whom he had tried to complain about this guy at Hewlett-Packard who thought that his invention wasn't really worth anything.

In the meanwhile, the venture capitalists and his colleagues had paid a large sum of money I won't name at Berkeley to look at the same thing. He had gotten back to them after he said weeks of study to tell them that the idea won't work for the same reason I had given in five minutes the other day. The venture capitalist felt that I was worth at least as much as the professor who had cheated him out of a sizeable fee. [laughter] This was the only reason he wanted me, and I told him, "No, no thanks." I wasn't interested. He kept after me and one day . . . then there was another venture capitalist—

JONES: Who was this? Can you—

ELETR: I'd better not. I'd better not mention. Then another venture capitalist whom I had met and known socially kept trying to interest me in doing the company with him. His way of interesting me in doing a company with him was whenever I met him, he'd reach into his jacket pocket and pull out a check for seventy-five thousand, one hundred fifty thousand, two hundred thousand dollars saying he had just gotten this from participating in a company. He said, "It's

[2] Herbert W. Boyer, interview by Arnold Thackray, Sally Smith-Hughes, and Mark Jones in Boston, Massachusetts, and San Francisco, California, 28 March 2000, 24 April 2013, and 21 May 2013 (Philadelphia: Science History Institute, Oral History Transcript # 0193, in process).

much easier. What are you working for?" At the time, the head of department at the Hewlett-Packard laboratory made seventy-five thousand [dollars] a year, and this guy would pull out checks of twice that amount every week telling **<T: 50 min>** me, "What the hell are you working for? That's the kind of thing you'll get."

I kept telling him, "I haven't invented anything. I don't know." He wanted me to start a company with him.

JONES: Can't name him either? Can you name him?

ELETR: Wait a second. Let me decide. I'll name him if you won't make a caricature out of him as I just did. About the checks and . . . we became—

JONES: That was a joke? He's doing—

ELETR: It wasn't a joke. He really was proud of the fact that he was trying to prove to me that working for a salary didn't make any sense, that if one had something up there one should and if one could [they] should use it to better effects, and it wasn't necessarily for the check.

JONES: But this does say something about the environment at the time?

ELETR: It does, it does, it does. But to me it was not a positive thing. It was not a positive thing because I've always felt and I still feel that to do something just for money doesn't appeal.

JONES: Yeah, but this is the idea that, well, you can do a lot with . . . you're doing something here for Hewlett-Packard, but you can do . . . there are lots of other things to do and we can help you do it, right?

ELETR: That in itself was never a motivator for me. Let's leave it at that. When the first venture capitalist whom I tried to shake off came back to me with another idea, that other idea that he had was to get me involved with this Leroy something or another down at Caltech who was in the process of getting involved in a company called Amgen [Incorporated] and they wanted to develop a protein sequencer. That was the protein sequencer that I was in the process of turning down from the perspective of Hewlett-Packard. The other guy came back with an idea. I mentioned it to the other guy, who wanted me to start a company with him, and he of course was one of the guys who were interested in Amgen also and he knew about the thing. That's how I got involved with the idea of maybe getting involved with the protein sequencer,

and after the conversation with my boss at Hewlett-Packard and telling him that, "Is there a problem? I've already turned this down. It was offered to us, and you told me it was not for us, and so did your boss, and would it be okay if I went and tried to do something with it?"

JONES: That you would leave?

ELETR: I would leave Hewlett-Packard, yeah. I decided to leave Hewlett-Packard, and it was in '79. Through the second individual, who was Moshe Alafi, I met Bill Bowes, and Bill flew down to Caltech with me to meet Leroy Hood and in the meanwhile, I managed to spend a couple of hours in the library to learn about the Beckman protein sequencer that Leroy Hood says he had modified. Anyway, that started the process and—

JONES: You looked at this sequence, and you thought, "Okay, this could work"?

ELETR: It took me a while; it took me a while. Here there's one thing I really need to say. I think more than anything, of all of the things that I read or studied or looked at, or people I talked to during this period when I was trying to make up my mind whether to leave Hewlett-Packard, and get involved in this . . . the one element that really guided me towards doing it was the persistence with which Bill Bowes made himself available. The amount of time he spent with me to reassure me, to prod me, to push me. **<T: 55 min>** Maybe in retrospect I'm exaggerating it a little but it stands out in my mind as the important catalyst, and this is a little chapter I want to open here because I think I alluded to that in the letter I sent here after I was invited to the meeting the other night.

The only reason, the main reason why I made it a point—since I'm living abroad now—to be here during this period was to come to the meeting because I wanted to this opportunity to basically tell Bill Bowes what I just told you. The venture capitalists that I ran into the context of Applied Biosystems were [Franklin] Pitch Johnson [Jr.], Bill Bowes, Moshe Alafi, and the assistant to Pitch Johnson at the time was Craig [C.] Taylor now at Alloy [Ventures]. Craig came in a little later in the process, but he was also of the same caliber if you will a very human caliber rather than a business-school machine. I found my work in the context of these venture capitalists who operated primarily on the basis of their emotional assessment of an individual rather than, you know. Several others became investors in Applied Biosystems in that one round of financing. Applied Biosystems did only one [round]. There was some seed money initially, but there was only one major round of financing.

Now, all the people who came in, they basically came in after fifteen minutes' meeting with me, on which they decided the horse's teeth look good, I'm betting. They may have had a whole bunch of credit agencies going after my past or something like that—I don't know—but the fact is that my feeling is that guys like Moshe, guys like Bill, guys like Tom [Thomas J.] Perkins—no, sorry, not Tom Perkins—Tom Pettifer got involved with Jim [James] Kliner.

There were people who they met you, they assessed you, and they decided based on that that they would bet on you. At the same time, they would also trust your judgment and not interfere with it unless it looked crazy.

JONES: And you had the same sense, that this is the basis for—

ELETR: I think the sense that I had was that I knew nothing about what putting the company together was going to be. I needed a lot of information on that; I needed to learn about the process, and these people were willing and able to spend the time to answer a lot of questions which today I would consider stupid. But Bill would pick me up in his car. He had a convertible two-seater Mercedes at the time. He said he loved this car and it was a gift from his wife. Red two-door, little 220SL or something like that, those days. He'd come and pick me up, we'd go and visit, we'd fly down to Caltech to meet Leroy Hood, to meet the chancellor's office at Caltech in the process of negotiating **<T: 60 min>** the license and trying to get a license. Whenever I had questions about anything I'd just call him and ask him, and so whether it was he or Pitch or Moshe . . . . I mean, I got in the habit of having breakfast with Moshe at least once a week at his house, just to—

JONES: He was also in Berkeley?

ELETR: Yeah, yeah, he lived in Berkeley too. I learned a lot from them without ever feeling that I was being tutored. [laughter**]** I would like in some way to acknowledge that. The other one is that if you talk to some of the early employees of Applied Biosystems, you'll probably get similar reactions from them in the context of how I tried to treat them, how I tried to run with them, which is a behavior I basically copied from Bill Hewlett. As a matter of fact, I remember writing a letter to Bill Hewlett—I think it was two years or three years into Applied Bio—thanking him for what I had learned at Hewlett-Packard that enabled me to rapidly get [going]. We had a startup in which a lot of people were hired who had never had any industrial experience. There was only one person who had industrial experience and without whom I couldn't have made Applied Bio that was André [F.] Marion, who I met at Hewlett-Packard. I gathered the group of people, some of whom were fresh out of school and who had never had any industrial experience, and with André's help created an atmosphere that was able to ship the first revolutionary instrument that protein sequencer lists a year and a quarter till we started. It fell off the truck . . .

JONES: Right, right. [laughter]

ELETR: But anyway, but it didn't break. [laughter] It used to be at any time of the day or night you went to Applied Biosystems there was one or two cars; there were people working. There was just this enthusiasm of creating something.

JONES: And Hewlett-Packard, you're going through the process of looking at this opportunity and thinking, "Okay, do I jump and do I get involved with this?" You were involved in negotiating the license from Caltech. Was that before you left or was it after?

ELETR: I wasn't negotiating a license with Caltech before I left. Before I left Hewlett-Packard, I only had interactions with Moshe Alafi and Bill. Trying to understand what was involved and so on. When I decided to leave Hewlett-Packed and I told when I was going to leave and left my house in order over there. That's when I started to negotiate. My arrangement with the five venture capitalists who were at the origin of Applied Biosystems was I leave my job; I work for free—that would be my contribution. Each of the five wrote a check for fifty thousand dollars. I had two hundred fifty thousand dollars, and we created the company fifty-fifty for me and fifty-fifty for the five of them. That was before we were going to their venture firms to get the next money.

JONES: That was a pretty good deal for you? I mean, that's—

ELETR: When everything was all said and done and the company was running, I ended up with five or six percent of the company so in the end it was basically what a fair amount for a CEO [chief executive officer] was. I'm not complaining; they didn't try to cheat me in **<T: 65 min>** any way or anything like that. Then what happened was I wanted to get started and so what happened was I had two hundred fifty thousand dollars from these guys, and I managed to raise another two hundred fifty thousand [dollars]. The other two hundred fifty thousand dollars were fifty-thousand-dollar deposits from five institutions for the first five protein sequencers to be built by a company not yet incorporated for a technology not yet licensed and with a promise that it would be delivered without a promise of performance. Because I couldn't promise the performance since I didn't know enough about it.

JONES: So how did you do that? That's pretty good. [laughter]

ELETR: I did it, and I got five checks for fifty thousand dollars. One came from Amgen, which had just been financed and Amgen had Leroy Hood on his—

JONES: On the board, the advisory board?

ELETR: On the board and all that, so they were happy to give a fifty-thousand-dollar check.

JONES: Was there any thought at Amgen on developing? They had been talking to him about perhaps developing this instrument there?

ELETR: They had talked at one point about developing that instrument for their own use and in fact, one of the first interactions with me was whether I would fit in the context of Amgen or not. I went to visit Amgen with Bill Bowes and then told them that either you create an instrument that you're going to sell broadly, or I don't want to be involved. When they decided to do a standalone company, Amgen put the money in, so there was Amgen, Monsanto [Company], what's the big institute down in La Jolla, [California]?

JONES: Scripps [Research Institute]?

ELETR: Salk [Institute for Biological Studies]. Salk Institute, I think Centocor [Incorporated], and I can't remember who the fifth was. I got two hundred fifty thousand dollars from these, two hundred fifty thousand dollars from the five VCs [venture capitalists] so that's half a million. In today's money that's about four to five million. That was enough to start to the company, so it's only when I got this money in that the few people that I wanted to join me in Applied Biosystems left their jobs to join me.

JONES: And one was André Marion?

ELETR: One was André Marion.

JONES: Tell me about how you knew him at Hewlett-Packard and—

ELETR: Like me, he had grown up in France, so it was natural for us to meet in the context of Hewlett-Packard because we were in the same corporate laboratories. When I said, "You were educated in France? Did you meet André Marion?"

"No, I didn't." Actually, the way I got André Marion interested in this project was just before I left Hewlett-Packard, I started looking for people. I needed someone who knew electronics and so I first started recruiting people from the electronic shop that supported my department at the University of California, where I had built much of leading products for interfacing a computer to our magnetic resonance machine a few years earlier. I talked to them,

but they were part of the Berkeley culture; they didn't really want to work very hard. I interviewed a few other people in my milieu in Berkeley and didn't feel that they were really going to fit. I had already been seven or eight years at Hewlett-Packard so I was already—

JONES: Socialized, yeah.

ELETR: It was on the day when I decided to leave **<T: 70 min>** Hewlett-Packard I went to the credit union to clear out my account and take things from the saving account I had there, so I cleared it and on the way out of there André Marion walked in to do something with his credit union account. He said, "How are you doing? What's happening?"

I told him, "I've just cleared out my account."

"Why are you clearing out your account?"

I said, "I'm leaving and I'm going to start a company."

He said, "That's very interesting. What's it about?"

I told him, "If you have time, I'll come by your office and let you know. I've got to run right now."

I walked out because I had another interview that had been lined up, so I walked out and thought to myself, "God damn it. I'm looking for a guy that is exactly André's qualifications." I walked around and around, "André, the company's to build instruments of a particular nature. I'll tell you about it later, but would you be interested?" [laughter]

He said, "Yeah, why not? I'm bored where I am."

JONES: What was he doing at Hewlett-Packard?

ELETR: Remember the first calculator-watch that Hewlett-Packard made?

JONES: I don't remember it. I don't remember that, yeah.

ELETR: They made a calculator watch that didn't make it because it was . . . you had to press a button, LED would light up. It was the first of the generation of electronic watches before the Japanese started flooding, and so he developed that at Hewlett-Packard. He still has one that he carries with him. I had one that was stolen from me. Before that, he had worked with another

electronic company. I think he had worked with Marshall [Electronic, Incorporated], the electric calculator company, before he went to Hewlett-Packard. I didn't know him very well. We hadn't socialized much. We just would run into each other in the cafeteria and talk about our immigrant's adventures or misadventures. That's about the extent of our relationship.

But I knew about his work, and he had a good reputation in the company and so on, so that's why. I asked him to join me and he did. While he was working, we spent a lot of evenings at his house putting together a plan on what we needed and learning—the first proposal for Lee Hood was that we would build a kit that would upgrade the Beckman sequencers; that was his idea what the company should do.

JONES: You would have a built-in customer base with anybody who had a Beckman sequencer?

ELETR: Yeah, I know, but I said, "That's . . . you don't want to be an accessory to Beckman.' Either you do it right or you don't. That's what I decided to do is that if we're going to start Applied Biosystems, we're going to make a full sequencer; we're not going to build kits for Beckman.

JONES: Can you tell me about the first day? You went down to Caltech with Bill Bowes and your first encounter with Lee Hood?

ELETR: Yeah, it was the encounter with Lee Hood. It was no different than the encounter with Lee Hood the other night. Lee Hood is Lee Hood. He's always full of ideas and the future and what he's going to do, and he likes to talk a lot about what he's done, he likes to talk about what he's going to do. He hasn't changed. Of course. The interesting thing about the protein sequencer is that it was invented and the protein sequencer, the different between it and the Beckman was, the main contribution was that to sequence a protein you have to do a particular what's called Edman degradation, a particular chemical reaction for every amino acid in the chain you want to analyze.

The biochemistry removes that amino acid, allows you to analyze it, then goes back and removes the next end of the amino acid. It can only cleave the protein at the end amino acid. When you do that you have different cycles in which you do a reaction, then you have to wash the result of that reaction, do more, and wash. Every time you wash, you wash away some of the original protein so after a number of washes, there's no more protein left and you can only go such a length. Someone had the bright idea—not Leroy Hood—had the bright idea of doing that chemistry in the gas phase and by doing it in the gas phase, all of the reactions are done with vapor. The vapors don't wash anything and only the last wash to wash the results of the reaction—there's only one wash instead of five or six washes **<T: 75 min>** per cycle so you can go much farther down the line.

JONES: Who was that?

ELETR: It was Lee Hood's PhD advisor.

JONES: [William J.] Dreyer?

ELETR: Dreyer. Dreyer had developed the gas-phase sequencer, had formed a company to try to build it and had failed, and Leroy had taken the basic idea of the vapor stuff and adapted it to his Beckman sequencer. Leroy's very imaginative, and he's also a little bit of that same streak of finding a good idea and taking it and putting there.

JONES: The venture capitalist, Moshe Alafi, and Bill Bowes, they knew this history would drive—

ELETR: Sure, sure, of course, of course. It was never hidden. It's just that Bill Dreyer's not the self-advertising person that Leroy is. The negotiation, when the negotiation started with the board of trustees at Caltech and the licensing office at Caltech, a lot of discussions went on and many of these discussions needed the support of the venture capitalists who were presented by Bill Bowes at the time. Simply because from Bill's past there was a resume behind him and so he lent credibility to the fact that the company was going to happen. He was involved in this, and I participated in some of them. Caltech had tried to sell . . . this is something I'm not sure if—I'm going to tell you right now—it's totally accurate or not. You may want to verify that with Lee. Caltech had attempted to license or at least I think or was told they had attempted to license the technology to [E.I.] DuPont [de Nemours and Company], to Beckman, and to someone else but I don't know.

Critical to that handling of the chemistry and the vapors that were involved in that gas-phase sequencer was a particular valve design that had been developed not in Leroy's laboratory; it had been developed at the Max Planck Institute that Leroy had basically copied by a handmade process by a machinist in his laboratory, who was an exceptional machinist and was able to do this very complicated valving arrangement. As I recall or as I recall having heard, when whether it was DuPont or Beckman or anybody else or somebody else they had talked to, the machining of these valves and the manufacturing of these valves was deemed to take probably more time than might be worth for the development of an instrument. Part of the licensing may have been that they have promised not to be able to do anything until a year or two of development because these things were difficult to manufacture and so on.

While these discussions were going and while Bill was trying to ensure that we would get a hearing from the appropriate licensing people, I had had one of my engineers at Hewlett-Packard, whom I had eyed as being a potential recruit for Applied Biosystems, look at the problem. He had found another machinist who was an employee of Hewlett-Packard but who also had a machine shop in his house where he moonlighted over the weekend. He had gotten this guy **<T: 80 min>** to make, to actually manufacture a valve relatively easily. When I went to talk to the trustees and they said, well . . . somebody said to me—I don't remember exactly—but somebody said something to the effect of, "What makes you think you can manufacture this since we have already been told by . . ." I don't remember who they quoted, ". . . that this would take years to develop?"

I said, "No, it won't take years to develop; here it is."

Which was much to the chagrin of Leroy Hood's machinist who thought he was going to be making the valves for us at the very expensive price. We found a way for that guy to make them really inexpensively. Interesting sidebar that illustrates the environment that we have here, this machinist who was moonlighting at Hewlett-Packard, when we formed Applied Biosystems started manufacturing our machines. We contracted with him to make this valve for us. He created a small company that is now a much bigger company, and he still offers to do anything I would get him to do if I would just start another company. But he employs forty or fifty machinists in his shop and so it's—

JONES: Yeah, where's he at? Where is his company at?

ELETR: His name is—my memory's playing tricks on me—it's Joe [Joseph] Ilmberger, and his machine shop [Ilm Tool Incorporated] is in the Silicon Valley here. I don't know if I have it here with me. Let me double-check.

JONES: We can find out.

ELETR: No, I don't have the name of his company here.

JONES: Yeah, that's fine, sure.

ELETR: You can look him up.

JONES: Yeah, well, I have a couple questions. Did that cause any kind of friction with Lee Hood's lab, the fact that—

ELETR: I think to some extent it might have because it removed another excuse for saying collaboration.

JONES: Yeah, yeah, and what about Hewlett-Packard taking people?

ELETR: I think that, at the same time as I was forming Applied Bio we got started, and when we got started it was with the five hundred thousand, the fifty times five from clients and VCs. That's when I got about seven or eight people, of which all but two came out of Hewlett-Packard. At the same time, while I was doing this, I had maintained a good relationship with Dean Morton, who had been my first introduction to the labs. As a matter of fact, I had a long discussion with Dean about whether he would join the board of Applied Bio, and it was not called Applied Bio at the time; it was still Genetic Systems [Corporation]. I got on the day before Hewlett-Packard announced their collaboration deal with Genentech called HP-Genentech. Do you remember that one? You've seen that one?

Dean Morton told me, he said, "Something will be announced tomorrow—I can't tell you what it is right now—but this will prevent me from being on your board. It would be a conflict." There was no hard feeling on the part of Hewlett-Packard. I think Hewlett-Packard prided itself . . . . I wrote that letter to Bill Hewlett, he responded back, he says that he was very happy that he may have contributed. [It was] generous of me to think that he had contributed to my ability to do this but over the years it was Hewlett-Packard had contributed to **<T: 85 min>** much of what happened in the Valley and will continue to do so. It was—

JONES: That's pretty much the culture.

ELETR: It was always almost a normal thing to happen but, yeah, the thing is it doesn't happen very often. It's very hard to draw people out of Hewlett-Packard; it was very hard to draw people out of Hewlett-Packard.

JONES: Because it was the leading . . .

ELETR: It was you had a secure job there. When people who asked me at the time when I was considering leaving go, "Isn't it risky for you to leave?"

I said, "What am I risking? I can always come back."

JONES: You had that sense that you could?

ELETR: Yeah, yeah.

JONES: Did you have conversations about that with anybody there?

ELETR: No.

JONES: It was just understood?

ELETR: It was understood. I mean it was clear that if I failed . . . actually the fact that you had gone to try something and failed put you higher up on the list of possibilities to become a manager than anybody who had not done anything. Which is very different from the Hewlett-Packard of today.

JONES: The two people of the original group that you brought in, mostly they came from Hewlett-Packard, but the others are these Berkeley people or . . . ?

ELETR: No, no, I think all except the two came from Hewlett-Packard. Originally.

JONES: Yeah, the two, who are the two? Where did you find the other two?

ELETR: I think André was the one who was in charge of looking for engineers. When we started the company, André was the chief engineer, and I was the CEO, chairman of the board, and head of research, and I retained this head of research title for three years, until I convinced Michael Hunkapiller to leave Caltech and join us. Mike joined us just on the eve of going public.

JONES: Yeah, and he was in Lee Hood's lab when you originally went down there—Mike Hunkapiller?

ELETR: Mike and Lloyd [M.] Smith, who's in Wisconsin now.

JONES: And so you met them and—

ELETR: I met them and I knew what they were doing. I had Mike spend a lot of time explaining to me the chemistry and writing up things for me and for me to look up and so on and so forth. I never hid from them my ignorance and they were very helpful in trying to fill it where needed.

JONES: Did you have some kind of formal arrangement with them for consulting, those guys in particular or . . . ?

LEETR: Lee had the consulting. I think Lloyd may have had a consulting arrangement—I can't remember. I know Mike had a consulting arrangement for a while before he was pulled out of there and I think that's about it.

JONES: Was there ever any question of locating the company down there?

ELETR: No.

JONES: And why not? Amgen was there, down that way.

ELETR: Yeah, but I lived here.

JONES: Okay, so . . .

ELETR: As a matter of fact, the reason why Applied Biosystems was located in Hayward, [California], is because it was halfway between Berkeley and Palo Alto where André lived. The bulk of the other Hewlett-Packard people I was going to hire lived closer to Palo Alto than they did to the North Bay, so I said, "I'll commute halfway if you guys will commute halfway." And the other reason also was that we were the first company to locate in the Hayward area, in what is the big industrial park right now in Hayward. Just to be faithful to the mythology, we rented a garage in Foster City, [California], for the first nine months of the company until such a time as the first building went up in the complex where the company's located now. I signed a lease for . . . . I think it was about one-third of the space of the building that we occupy with an option on the additional space. Over the seven years that I ran the company, Applied Bio took over the whole building and five others in that complex.

JONES: Hayward, was it a conducive environment in terms of they were happy to have you, to—

ELETR: I'll tell you something now. I don't know if it gets published if it's going to cause me to go to jail or not. [laughter] The other reason why André and I located in Hayward is because the site where we were going to be was right next to the sewage treatment plant, which we used to smell every now and then. We figured that if per chance **<T: 90 min>** our ability to control the emanations of the building, that the toxic chemical—not toxic but the very volatile chemicals—that we were going to use at Applied Bio, people would think it's coming from the sewage treatment plant and won't bother us. Okay. [laughter] Because we use ammonia and trifluoroscetic acid.

JONES: That's the gas?

ELETR: Yeah, it's a liquid form but the ammonia also evaporates and yeah, stinky stuff.

JONES: And is it a stinky machine, or was it a stinky machine originally?

ELETR: You have to evaluate its property and all that, yeah.

JONES: How did the work proceed? Was it smooth sailing, or were there difficulties trying to get this thing to work?

ELETR: If I remember correctly now, at the time of the protein sequencer, I hired, I remember specifically of—two biochemists that I hired and a third one who may have come a little later—I can't remember now. The ones that I hired were always people who had been overlooked somewhere else. I tried to hired people that had the same, a similar path as mine where you tried to do something in a big way in some place, like I tried to do something with UCSF, and I failed at it or I couldn't. I didn't quite fit. I knew that a lot of people may have that problem, although they have certain qualities that you could exploit also. I wouldn't tell them that today because, but in fact if I knew they were eager to succeed or to do something really worthwhile. One of them now, he failed again; his last effort was failure. He was the Chief Scientist at Helicos [Biosciences Corporation] in Boston. Bill [William] Efcavitch.[3]

[3] William Efcavitch, interview by Mark Jones in San Francisco, California, 7 March 2014 (Philadelphia: Science History Institute, Oral History Transcript # 1000, in process).

JONES: Oh, yeah, yeah, okay.

ELETR: He was one of the first biochemists I hired. Not for protein sequencing. He got hired for the next, what I thought at the time was going to be our next product and which became our next product—the DNA synthesizer. Bill Efcavitch had done his work in Denver, [Colorado], with [Marvin] Caruthers.[4] Caruthers didn't really think very highly of Bill; that's why I hired Bill. Bill is the one who had really gotten the chemistry to work in Caruthers' laboratory and Caruthers is, to my mind anyway, did not recognize adequately Bill. Because Bill is a little bit of a self-effacing, subdued individual. He's not a self-promoter. I hired Bill. Bill, unfortunately, he did a good job at Helicos, but I think from the start—

JONES: The technology?

ELETR: The technology had flaws in it. I looked at it at the very beginning and didn't want to get associated with it. He's now . . . heads a big group at Affymetrix [Incorporated]. He had good substance to him—Bill. The other one was I think Norm [Norman] Whiteley. He was a protein chemist who joined it. I don't know what he does now; I think he retired after we went public. He worked very hard at getting the protein sequencer to work. There were one or two other biochemists that we hired and a group of mechanical engineers and electrical engineers are the ones who really made the machines. I wouldn't have been able to do that unless André and I knew what kind of people we wanted to recruit for this. There were generally young scientists fresh out of college **<T: 95 min>** or one or two years' experience. That's it. The two of them are now involved in another sequencing startup. Okay . . .

JONES: And this group, this is the sole project? Yeah, how are we doing on time?

ELETR: It's your time. I have to be in Berkeley by 6:30 [p.m.].

JONES: Okay, so how long does it take you to—

ELETR: Around forty-five minutes on BART [Bay Area Rapid Transit].

[4] Marvin Caruthers, interview by Mark Jones in Boulder, Colorado, 11 April and 11 June 2013 (Philadelphia: Science History Institute, Oral History Transcript # 0985, in process).

JONES: Yeah, okay, okay. The protein sequencer's the sole product that you're working on initially?

ELETR: We started with the protein sequencer but immediately after that started with a DNA synthesizer. The DNA synthesizer, this is why Bill Efcavitch joined us after I got a license from Boulder for the chemistry.

JONES: Was this something that at the beginning of the company would Bill Bowes and Moshe and Alafi say, "Come build this protein sequencer and then we're going to do a DNA synthesizer"?

ELETR: I'll have to find it in my files. I did not have time to look for it before our meeting today but I fully intend to find it in my . . . actually it's in a document—in a PDF document—on the computer I had before I bought this iPad. I'll e-mail it to you. It's the first handwritten, one-page business plan of Applied Bio, on which it had the protein sequencer, the DNA synthesizer, the peptide synthesizer, and DNA sequencer. That was the plan that I had made at the beginning. It was only after the DNA sequencer was ready to ship that combination of some hard problems and other results of a very exciting but a very stressful seven years. It was seven years I didn't take a vacation; I didn't do anything except . . . so I fulfilled those four things, that was—

JONES: Do you remember the discussions putting that together? This is discussions with [whom], Lee Hood and with—

ELETR: Nothing, as I said earlier, originated with me. It's just that when we first started talking, Lee Hood was the protein sequencer. I don't remember in what particular discussion or in which particular moment, I must have asked the question, "If we're going to do a company to do the protein sequencer, that's not going to be enough because you have to have other products. What are the other likely products?"

I think from these discussions came the . . . let me backtrack. When I started the discussion, the visits with Amgen and learning a little bit about Amgen and who was involved, I learned that Leroy Hood and Marv Caruthers were involved in a project collaboration between them to help sequence a particular protein at Amgen from the sequence of that protein find out what was the DNA sequence that coded for it so as to synthesize the DNA probe and fish out the gene.

The only way you could find out the DNA sequence in those days, even though the DNA-sequencing biochemistry existed but was very difficult to use manually, you couldn't get enough bases and all that. If you knew the protein sequence, you could design a probe to fish

out the gene and after fishing out the gene maybe, you could sequence it. They were working on that. The notion of using **<T: 100 min>** the manual chemistry that had been developed in Marv's laboratory to synthesize DNA, the purpose was to use it to synthesize a DNA probe for that so that Amgen could know what gene to work on.

Lee and Marv had some kind of agreement—I don't know the details of it—to work together. From these discussions, it was natural that a next product would be a DNA synthesizer. Since you're sequencing the protein to be able to make a probe so you can fish out a gene, you would want to enter that protein sequence into a machine that would give you the probe. Why not automate that manual chemistry? After we got the sequencing license for the protein sequencer from Caltech, we said, "We're going to be using the same valving that was developed for the protein sequencer."

Since we knew how to manufacture it in Joe Ilmberger's shop, we could not . . . these valves could also be used in a DNA synthesizer; we wouldn't have to do much development for it. "So let's plan on doing a DNA synthesizer and automating that chemistry. I'd like to have a license to that chemistry from the University [of Colorado] at Boulder."

The University at Boulder was hesitant about giving us a license because we were a small company; we hadn't proven ourselves yet. The protein sequencer hadn't come out, all that kind of stuff. Clearly, Leroy wanted us to have access to that chemistry as he worked with Marv because he himself got a nice chunk of Applied Bio for one thing in the process of starting it. The economic interest always spices things a little. He was rooting for us to get that, both because he was interested for it to come out of the same thing that he had helped create and he was working with Mark. They had this arrangement for Amgen. But Boulder wanted to license this chemistry to Beckman and—

JONES: Just because of the traditional relationship they had had with Beckman?

ELETR: I don't know; I really don't know. Beckman was a big player in those days. I don't remember—this is something you might have to check with someone else or in the records—I do not remember if the notion of using that same valving that we used for the protein sequencer was mentioned in the license from Caltech to Applied Bio for the protein sequencer if mentioned it was made of the DNA synthesizer or not. Because it was obviously on Leroy Hood to get involved in the DNA synthesis, okay? I don't know. But Arnold [O.] Beckman . . .[5]

[. . .] There was an issue with getting the DNA license, the license from Boulder, and Arnold Beckman had been a little bit upset I think as to why Beckman did not get the protein-sequencing license and we did. I think the reason we did is because we made an argument that

[5] Arnold O. Beckman, interview by Jeffery L. Sturchio and Arnold Thackray at the University of Pennsylvania, Philadelphia, Pennsylvania, 23 April 1985 (Philadelphia: Chemical Heritage Foundation, Oral History Transcript # 0014).

we could make those valves much quicker than the others. That's the thing I wasn't sure of I told you earlier.

JONES: Yeah, and so this, the valve, I'm not sure what it does but it's something common to both the sequencer and the synthesizer?

ELETR: The valve was used in all four machines that Applied Bio built, the protein sequencer, the DNA synthesizer, peptide synthesizer, and DNA sequencer.

JONES: And this is a key piece?

ELETR: It's a key piece and I—

JONES: It came from the Planck Institute?

ELETR: I found out later that it came from the Planck Institute. That's one thing that Lee doesn't always advertise where he gets his ideas from, and so I had to travel to Berlin, [Germany]; that was before the wall had fallen. I traveled to Berlin and there was a husband and wife who ran a laboratory in Berlin. I forget their name now. They had filed a patent on that valve and had to get a license for the valve before we commercialized that instrument.

I was scared for a while that they might exact a huge thing, but I was able to negotiate a reasonable thing. It took several trips to Berlin to do it, but we made it. One of the things that I learned at Hewlett-Packard is that if you have a particular trick that works well and you can use it in a variety of applications, that's what you should do. I built the company around that valve, and I had found the machinists who could do it and then we tried. I gave him an opportunity to create his company to do it; he's forever grateful. He did a good job. That's how things work in the Valley. Okay?

JONES: The DNA synthesizer was the—

ELETR: We had a problem getting the license from DNA synthesizer and at the time we wanted to get the license, Beckman made noises about trying . . . it was a time when—and I'm not sure of exactly the details—in fact I'm talking about some hearsay stuff here. There was a big building that Arnold Beckman had promised to Caltech that was just called the Beckman Building now or something. I heard from either Lee Hood or one of Lee Hood's people that Arnold had threatened to withhold putting that building unless his company got access to the

DNA chemistry because it was too late to get the protein sequencing that had already been done. It was a little bit of an issue and Marv himself wanted, felt that his chemistry was probably worth more than what Applied Bio was willing to pay for it and he wanted to go and commercialize it somewhere else.

JONES: He may have been right about that, too. In retrospect looking back at how huge . . .

ELETR: Few games were played at the time. My game was having worked at Hewlett-Packard and knowing that Hewlett-Packard was likely a better company than Beckman, **<T: 110 min>** and even so things took time for products to come out of Hewlett-Packard, so I figured it'd take even more time to come out correctly out of Beckman. I said, "Give us two co-exclusive license." This way Arnold is not going to scream but I'll be in the market two years before him anyway. Which this is the way it happened.

JONES: So they did start working on it?

ELETR: We started working on it—

JONES: No, at Beckman, did they—

ELETR: Yeah, they started, they got a license too, they got a co-exclusive license.

JONES: You're keeping an eye on what they're doing; you know who those people are and what they're up to?

ELETR: Now you mean?

JONES: No, then.

ELETR: No, I wasn't concerned. I knew they'd be two or three years later than us and they were. I mean, that's basically what happened. I knew that the engineers that I had who had produced a protein sequencer with a much more complicated chemistry in less than a year would do my DNA synthesizer in a year-and-a-half. I thought, okay, and I knew Beckman would take two, three years at least so that's fine. We got a co-exclusive on that one and so . . .

Now, in terms of convincing Marv, I think his collaboration with Leroy Hood was important to him and I think Leroy wanted that. We gave Marv a nice stock option in the company. The one thing I remember about Marv—I don't know if you want to put that in your thing, you might . . .

JONES: You'll get a chance to review everything.

ELETR: You'll do it in a more diplomatic way than I'm saying it. No, but I think it's important information, but the trick is how to word it without offending. The one thing I remember about Marv is that every time we met he would always finish the discussion by asking me is there any way he could get more stock. Marv: "Is there any way we can get more stock?" Leroy Hood: "Is there another institute who would develop?" [laughter**]**

JONES: Now at the time you completed the DNA synthesizer, this is after the company's gone public or prior? It's '83, I think?

ELETR: Eighty-three, the public offering, I think. You have all the annual reports, don't you?

JONES: Yes.

ELETR: You should be able to find it. I haven't remembered, I don't remember.

JONES: But what I really want to hear is at the business end you've got the protein synthesizer on the market—

ELETR: Protein sequencer.

JONES: Or the sequencer, and that's the first product?

ELETR: That's the first product.

JONES: That changes the company, yeah? Then you have revenues and—

ELETR: Yeah, when we went public, we had positive revenue. At the time we went public we were profitable.

JONES: Right, which is unusual for a biotech company but—

ELETR: Well, we're an insulin company.

JONES: That's right. You're growing, the company's changing and you have to . . . this is the first company you've run by yourself, right?

ELETR: Yeah.

JONES: And how was that process, managing all of that?

ELETR: Well, I think the process of managing it was modulated a lot by two things. One is that the manner in which we'd chosen the [employees] in the company. By and large, they were chosen based on a number of criteria. One, they were not stars in their field or advertised themselves as stars in their field. Mike Hunkapiller was an exception to the rule because the amount of value that he brought in was far greater than any negatives I saw in his self-promotional stuff.

JONES: He strikes me, as kind of a quiet, self-effacing guy, is that not . . . maybe just in relation . . . relative terms. [laughter]

ELETR: No, no, no, Mike, he's convinced that he knows it better than anybody else. Which is not always true.

JONES: But it's not necessarily always bad to have that conviction.

ELETR: No, no, fair enough. **<T: 115 min>** I figured that as long as in the final analysis the decision is made by me or André or by other people around him, that's all right because he's also an honest individual. He may have a conviction, but if I can sit down with him and reason with him and show him why I want to change it or something, he will fight it. He's reasonably balanced. But all I'm saying is, as I made the exception, that he is a star in the field—there's no question about it—from the work that he had done with Leroy and all that. However, the other

thing is that he was also a failure in the field because he wanted to because a [professor] at Caltech and he didn't. That's why he came to Applied.

JONES: I didn't know that. When he arrived, where was the DNA synthesizers? Did he work on that or was that after?

ELETR: No, he came and continued to work on refinements of the protein sequencer. The DNA synthesizer was Bill Efcavitch's job.

JONES: I see, okay, yeah.

ELETR: Bill Efcavitch managed the—

JONES: Mike was hanging around at Caltech, trying to get onto the faculty?

ELETR: That's my interpretation. I think Mike didn't like being in the shadow of Lee because he's a good scientist also. I won't make a judgment as to whether he's better or as good as Lee or something; that's not the point. But he's a good scientist, and he's a measured individual and I think—I'm not sure—I think that he wanted to have . . .

JONES: His own lab, yeah?

ELETR: He wanted to have at Caltech what Lloyd Smith got at Wisconsin. He and Lloyd were together in the lab with Leroy; they were postdocs at the same time. One became a professor and the other one came to Applied to run a project and a year or two later I made him head of research.

JONES: Yeah, and that process, how did you ask him?

ELETR: What?

JONES: To come?

ELETR: To?

JONES: You had something in mind for him at Applied Bio?

ELETR: I wanted him to come from the day of opening the company. From the day of starting it, and as a matter of fact, the first thing he tells me his wife didn't want to move to the North Bay. She didn't like it and all that; it was going to be costly. She didn't like the San Francisco area. I don't know whether that's true or not but that's the excuse he provided. I invited him and his wife on company expense to come and spend the weekend. I took him out. I worked very hard at convincing him and her to come there because I knew that Applied Biosystems, for the creation of the next generation of products that would have to come out, needed someone like Mike to complement the people we already had.

JONES: As CEO how was the IPO [initial public offering] process?

ELETR: We are getting into a chapter that I worked on in my book—nothing to do with the IPO process but having to do with my biggest problem with the IPO process was to keep the CFO [chief financial officer] out of it. Which I did. Before we get to IPO process, I want to get to the five point something million [dollars] that we raised to start the company. We started the company now remember with the five hundred thousand dollars that came as advanced payments. Following that I had to make the rounds of venture capital firms that were . . . on the one hand the venture capital firms were . . . . Bill Bowes at the time was forming his

As a matter of fact, Applied Bio, I think was a second investment by US Venture Partners. Amgen may have been the first, and Applied was the second, and I think the third **<T: 120 min>** or fourth was the cheap clothes company, Ross [Stores Company]. I always found it funny to be in company of Ross, but Bill was forming that company. His fifty thousand bought him 10 percent of the company and as were the other fifty thousand, there were four others. Moshe got 10 percent that way. I never knew exactly whether this fifty thousand that each put in came out of their own pocket and went to stocking their personal name although it went to their firms because their firms came later at the higher valuation. Whether they used that process to . . . . I don't know. I never looked into it.

The fact is I had to go to their firms where the firms they were associated with . . . clearly Pitch Johnson's case, it didn't make any difference because his firm was his money. I had to make the rounds in the venture capital firms; I had to go see Gene [Eugene] Kleiner. I didn't see Gene Kleiner initially. It was when we were about to close, about a couple of months before we closed that deal, that I got a call from Brook Byers, who was assistant for Gene Kleiner at that time. His name was not yet on the firm and so I got a call from Brook Byers. "I hear you're starting your company and you're raising money. How come Kleiner Perkins was not invited?"

I said, “Because I don’t need them.” It’s true. I didn’t know who they were, I mean.

He said, “No, no, you definitely need us. We can open lot of doors for you.” And so on and so forth.

I said, “Who are you?”

He gave me his name again and he said, “I work with Gene Kleiner. You can tell Moshe Alafi and Bill Bowes the same. I had already heard that they were involved and all that.”

I called Bill Bowes and said, ‘Do you think it’s worth having? You already have the commitment for under five million or something.”

Bill said, “An extra half million is not going to hurt. Besides, we can probably open a few doors for you.”

I said, “This is what Brook Byers promised that he will make some connections to open some doors.”

I called back. “Yeah.” I went to meet Gene Kleiner in Boston. Passed. I fit the profile that he was looking for I suppose.

Then there was Rothschild [& Company] Group. Rothschild Group in New York, [New York], at that time was run by Jim [James] Blair.[6] I went to see Jim Blair**,** Moshe**,** and Bill. I think had made the introduction to Jim Blair. I went to New York to see Jim Blair and he said, “The decision will be made in London, [United Kingdom], and you have to go to visit Rothschild in London.” [. . .]

I went to London in Saint Sweden Lane I was ushered in an office with the portraits of half a dozen Rothschilds—they all look alike—and old furniture. Green velvet covered table, a tray came in with some tea and cookies and I kept waiting. Somebody walked in and said, “I’m extremely sorry. Lord Rothschild cannot see you today.” However, he suggested to go and see Dr. Sydney Brenner in Cambridge, [England], because he never makes an investment in biology without advice of Sydney Brenner.” [7]

I have never heard of Sydney Brenner at that time. I took the next train to Cambridge and went to see Sydney Brenner and explained to him that I was a physicist by training. I tried to build the **<T: 125 min**> protein sequencer. [. . .] I didn’t know anything about it, but I thought that I could automate the various chemical steps that had been explained to me by Leroy

---

[6] James Blair, interview by Mark Jones at Domain Associates, San Diego, California on 11 April 2012 (Philadelphia: Science History Institute, Oral History Transcript # 0979, in process).

[7] Sydney Brenner, interview by David J. Caruso, Jacquelyn Boytim, and Mark P. Jones at Cold Spring Harbor Laboratory, Cold Spring Harbor, New York, 8 August 2014 (Philadelphia: Science History Institute, Oral History Transcript # 0916, in process).

Hood and Hunkapiller. He kept nodding his head a few times and he must have liked what I told him because what I heard from the Rothschild group a few days later that they were going to be co-lead of the investment.

JONES: Yeah. Later on, did he tell you, you know, his evaluation or what he thought of it?

ELETR: That was the beginning of my relationship with Sydney Brenner, which is still ongoing.

JONES: Yes.

ELETR: He thought the gas phase version of the chemistry very ingenious, and he was a little bit reluctant to admit it, but Sydney is an honest person. He only admits what really is. I think his reluctance came from the fact that the little bit of a public relation rivalry between him and Sydney Brenner**.** They like one another in the lab, but they are always little sensitive what the other guy is claiming and saying and so on. Then as a representative of the Rothschild who had made the investment, Jim Blair joined our board.

Sydney got in the habit of visiting us every three months or so to look at the progress we were making and what we were doing. Then one day he came in to say that, "We're probably not going to be able . . ." That was a few years later, he came and said, "I probably won't be able to come and visit you anymore, it will be a conflict for me. Because I have invented a twist on the chemistry that DuPont is going to develop the DNA sequencer."

He described it to me.

I told him, "It's a nice twist. I think it is an advance of what—"

He said, "You know I have been a consultant for DuPont for many years, and I think they can do it. So I can no longer, cannot be your consultant to you and be unfair."

I said fine. I looked at the thing. I told him, "Sydney, it's not going to work—not the chemistry that you invented but the way they're going to implement it—and the instrument is not going to work."

He said, "No, no, it will." They are putting a lot of money, but the end result of that story was a few years later DuPont gave the list of customers to Applied Bio and gave Applied Bio the chemistry that Sidney had invented that very much improved performance of the Applied Bio DNA sequencer. Then Sydney came back to be consultant of Applied Bio.

JONES: Okay, again, what was the improvement in the chemistry?

ELETR: You'll have to—

JONES: I'll have to look it up. Sidney Brenner is the famed molecular biologist hanging out with Watson and Crick. [. . .]

ELETR: Actually, Sydney Brenner is a very good friend with François Jacob in France, who is another Noble Prize winner and often comes to Paris to visit him, talk to him, and been associated. Jacob got the Nobel Prize for some functional RNA, and Jacob has always maintained that much of that work Sydney deserved to be part of it. I thought when Sydney got his Nobel Prize six or seven years ago.

JONES: I don't know the date.

ELETR: He got it for work that he had proposed thirty or forty years ago, and there was a time before he got the Nobel Prize where he used to like to brag that he was the only one who had been overlooked twice for it. Anyway, it is so.

JONES: **<T: 130 min>** We've talked about the DNA synthesizer.

ELETR: And then after that came a peptide synthesizer.

JONES: What's the different between the—

ELETR: Synthesizer

JONES: Right. Okay.

ELETR: Peptide synthesizer.

JONES: And the market for that is who is going to use these peptides?

ELETR: Drugs that you make or research on drugs that you make. Or you make some synthetic peptides and look at it. Here Leroy Hood introduced us to a scientist—whose name I forget now . . . he was from New Zealand if I remember correctly—who had invented a chemical means of assembling amino acids. I struck a deal with him because I wanted to complete the range of instruments. We built an instrument that sold for several years until the work switched to doing the same thing by gene splicing and manufacturing proteins in another way. It was a successful instrument paid for itself and for the years, it was just produced. Then after that came the DNA sequencer. The DNA sequencer, we started working on the DNA sequencer immediately at the same time almost as the DNA synthesizer, and it took several years to break it. In large part because we wasted lot of time trying to reproduce in a commercial version, the prototype or setup that Leroy had developed his fluorescence working, that comment I mentioned.

JONES: Yeah, so initially you had different chemistry . . . you had a different for each base, each nucleotide.

ELETR: I don't remember the details. I can give you the name of the chemist. I can't give it to you right now because it escapes my mind, I'll have to look it up and e-mail it to you. He was the biochemist I hired at Applied Bio. He published the paper that was published together with Lloyd Smith. Two guys on that paper of Lloyd Smith on the DNA sequencer—one was Lloyd Smith, one was Steve [Steven] Fung, and the third name escapes me right now.

JONES: Okay, we can find the paper no problem.

ELETR: Okay, you can find the paper and look at it, and it will mention the details of the chemistry.

JONES: But initially, the chemistry was that Lee Hood started it and then you developed the rest of it. You got a start and then developed the rest of at Applied Bio.

ELETR: The instrument development was really the one that took a lot of time. We had to develop an instrument capable of looking at four different colors; we had to develop four different dyes for which four different detectors could be used.

JONES: Right. This was . . . did you have any idea how big this would be—I mean, the implications? I mean, this enabled human genome project, right?

ELETR: It enabled the human genome project, but from the very beginning of . . . anybody who thought about doing the human genome project was in order to discover markers in the human genome project that would be indicative of disease. There was no question that developing a DNA sequencer would enable the development of diagnostic applications. However, I don't think that at the time anybody thought that the cost of sequencing DNA would be as low as it is today. I don't think anybody would have predicted that in any way. The cost of the DNA sequencing has come down much faster than we saw.

JONES: Right. They are putting this machine together; it takes maybe three or four years to complete?

ELETR: We started . . . . I think we probably started thinking about it earlier. But we started it in '82, <**T: 135 min>** '83, late '82 and we finished it and shipped the first prototype to the first ones in '86.

JONES: And by this time, Mike Hunkapiller is running research?

ELETR: Yeah.

JONES: He had a big hand in making this machine?

ELETR: No.

JONES: No. Not in terms of doing the technical work that run into it, but he is managing the process.

ELETR: He was the R&D [research and development] manager. I stopped being the R&D manager I think it was a year-and-a-half after going public or something like that. Even as R&D manager, the reason I kept that title is because I was determined to make sure that there was a particular unity in the family of instruments we are going to build. I wanted to make sure that things remain consistent, and I wanted to make sure also that the same process that went into developing and translating into a commercial instrument was followed.

Now, the one thing that I learned at Hewlett-Packard was that it was very important to make sure that the transition from a research product to manufacturing instruments is very, very carefully done. Done by the same people who followed from one to the other. Mike didn't know

anything about manufacturing, and even when the instrument was finished and manufacturing . . . a couple of things that were unique about Applied Biosystems. I don't know if they have remained after I left. But there never was a project manager who managed the whole project. There was someone in charge of the chemistry, someone in charge of the mechanics and someone in charge of the electronics, if needed, someone in charge of the software. It was a collective responsibility—the four of them to manage the project. I overlooked that to make sure that they didn't fight with one another, which they never did. I wanted also to make sure that the people who were involved in development moved with the instrument all the way up to the manufacturing process until such a time when the manufacturing people, which were technicians of a lower order in terms of education and accomplishments, could be kept trained in the process. Then there was the service engineers and service biochemists that had to be trained in the process, some of them came out of the R&D group and moved along to other aspects.

JONES: What would be the best way to sort of trace the technical development of this . . . of the product. Would we look at patents?

ELETR: The DNA sequencer?

JONES: Yeah, the DNA sequencer. All of them but that one particular—

ELETR: I think that if you talk to, if you manage to locate Cheryl Heiner, Steve Fung and the third one was named . . .

JONES: That's okay. We'll find it. But he didn't come from Caltech. He was somebody that you hired up here.

ELETR: Yeah. Nobody came from Caltech besides Mike Hunkapiller.

JONES: Yeah, okay. Okay. Right. Did Lloyd Smith . . . was he consulting on?

ELETR: He consulted for a while, yeah.

JONES: Which project? In which projects in particular?

ELETR: All of the DNA sequencer.

JONES: Okay, and Lee Hood was watching the whole thing too?

ELETR: No.

JONES: He was not involved?

ELETR: I made sure that he didn't. Nothing that I have anything against Leroy. What I did . . . one of the reasons Applied did as well as I did in the short time that produced four major instruments. Those were all successful, all money-making in six short years. It is very unusual, okay? The reason it happened is because I wouldn't allow any consultants or board members to interact with anybody in the company.

JONES: That's a Hewlett-Packard lesson or—

ELETR: I don't blame everything on Hewlett-Packard. [laughter]

JONES: You wanted to let them do **<T: 140 min>** their thing. Yes?

ELETR: I honestly don't know the right answer to give you. I think you may hear it differently from them, but I think I had a personal relationship with every one of my employees. Because nobody was hired without my interview with him or her. Everybody who was hired had to be hired on a unanimous vote of all the people who had been selected to interview. If anybody doubted, we didn't hire. We just wanted to make sure that people could work together and liked one another. If we did any discriminations at Applied Biosystems, we did discrimination against people that anybody didn't like no matter who anybody was. As a result of this, I think, I may be fooling myself into believing that I think I established a personal relationship with the employees.

I felt that that personal relationship was such that if there was any problem, they would come to me and let me know about it. They will never be scared of letting me know of any problem; whether it is their problem or a problem they have with anybody else. That if a board member came walking around and started finding out about problems or finding out about things they wouldn't know what to say. There was no point in doing that. As long as from quarter to quarter, sales went up and up and up, the board members were happy not to interfere.

JONES: And that did in fact . . . . I mean, you were introducing these instruments in—

ELETR: Look at the sixth year of Applied Biosystems's annual report, which is the hiring, revenue, and earnings.

JONES: Yeah. Enormously successful, but, as you said, it took a personal toll on you; you were feeling this along the way?

ELETR: I'm not complaining because I enjoyed this. It's the period of my life that I had enjoyed the most, but it did take a toll.

JONES: And so, you felt you had to resign in 1987?

ELETR: Yeah. I had to resign, and I knew that by resigning, it was going to create a problem, and I tried to manage that resignation as best as I could, but I didn't do a very good job of it.

JONES: I am not familiar. What happened?

ELETR: Stock dropped, of course, and recovered afterwards.

JONES: Is there something that you had thought about for maybe, you know, a year . . . ?

ELETR: No.

JONES: No? It was just a crisis occurred and then?

ELETR: It came the time, you know, I was traveling in Europe making rounds—the typical road show every six months or so one does to reassure investors in various places and all that. I had to cut short two or three meetings. I felt ill in one. I had decided I can't continue; I am going to have to let somebody else do it, for the good of the company only.

JONES: As time went on over the years, did you feel . . . . I mean, on the one hand, you're watching the company, what's going on inside developing these machines. You know you have

got the team and then managing everything else, you know, taking care of investors, taking care of Wall Street, and did that become a much bigger job as time went on compared to just running . . .

ELETR: The only thing I remember of my interactions with Wall Street is the following. In the road shows, it was meeting after meeting in rooms in hotels—big rooms usually—where a bunch of the veneer-covered chairs are laid out and you know that stuff. A group of people come and sit down and you give your talk, and some of them did notes, some of them don't. They ask you a few ridiculous questions after the meeting. **<T: 145 min>** The only thing I remember of these meetings is when they stand up and they turn around, all I see is the shiny bottoms of their pants or skirts because they have rubbed them all week and all month on little chairs like the ones that were with me without producing anything.

JONES: Okay, but it's still an important part of the job. You have to show up and do that? Yeah. You had very successful company then there must have been lots of people looking at it, we would like to take you over?

ELETR: Well, they did eventually.

JONES: Yeah eventually, but that was after you were going out. Were people knocking on the door while you—

ELETR: No. No. From the very beginning, I go in these meetings where people would show me their shiny bottoms, and they ask me questions about competition. I asked about what competition. We dominated every field we entered. Anybody called because they wanted to have an association, I am fine, but at what price do you want to sell me your company? I was very arrogant to the outside world. All the arrogance I couldn't exercise on my employees.

JONES: You really did have a sense that you had the best and that you were way ahead of everybody?

ELETR: It was.

JONES: Yes, obviously it was.

ELETR: It was. [. . .] After a two-year or three-year hiatus where I had to take care of some cardiac problems, I went back as a consultant to ABI, and it was just about the time when PerkinElmer [Incorporated] had made their offer and that's what got Lynx [Therapeutics Incorporated] started.

JONES: This would probably be a good juncture to stop. I would like to talk to you another time about Lynx and the other things you have been involved in the next time you are around. How often do you get over this way from a . . . ?

ELETR: I'm going to be in California until early March.

JONES: Okay, well, maybe between now and then.

ELETR: Then after that I probably won't be returning until May or June.

JONES: Well, that's not that far off. Your main company now is Population Genetics [Technologies Limited]?

ELETR: No, I've got three companies.

JONES: US Ventures.

ELETR: US Ventures Partner. It's Population Genetics, which I'm very busy right now recruiting a CEO for it. The former CEO was someone whom I had hired at Hewlett-Packard the first year I got to be head of the department there and who had followed me to Applied Biosystems. After Applied Biosystems, he got bored with Applied Biosystems some ten years ago—maybe twelve or thirteen years ago—went back to Hewlett-Packard just before it had split into Agilent [Technologies] and Hewlett-Packard.

He went back to the same section of Hewlett-Packard where he had worked, which had grown quite a bit, and then was split into Agilent. When it was split into Agilent, he no longer liked being there and so I succeeded in recruiting him to run **<T: 150 min>** Population Genetics. He said, yes, but only for three years because he doesn't want to do anything for longer than that, so we finished that a year ago. We're in the process of replacing him.

That company grew from ideas that Sydney and I had explored at Lynx and that the investors in Lynx and Solexa [Incorporated] were not interested in pursuing, so we decided to

pursue it. History repeats itself, like always. Population Genetics is now showing people how they can interrogate a thousand genomes in one test tube for a particular disease. So you don't have to sequence a thousand genomes one at a time; you can look at all of them in one part so that's what we're doing.

JONES: Yeah, no there's a lot there that I would like to talk about, that whole period from the early-nineties—

ELETR: I can show you the latest company I created; I'll just show you the products.

JONES: And this is in Paris, [France]?

ELETR: No, this one is in Geneva, [Switzerland].

JONES: Are you in Paris? Do you live in Paris?

ELETR: I have an apartment in Paris, yeah. It's starting?

JONES: Yeah, there it is. Okay, that's Andrew [Alliance].

ELETR: [music of video on phone in background] It just uses commercial pipettes; you don't have to buy it for robot and all of that kind of stuff. It uses commercial pipettes does the hand motions that you want it to do.

JONES: Yeah, you can program it to do whatever?

ELETR: Program it on one of these.

JONES: Yeah, great. You're selling them? Are they on the market?

ELETR: No.

JONES: Is this a prototype?

ELETR: Prototype. We started this company eight months ago. [crosstalk]

JONES: Great. Still have the same level, the same value? Still have the good model?

ELETR: Still recruiting good scientists.

JONES: That's interesting.

ELETR: The reason for Android is because that was the name of the first . . . it was the name of a robot in an Isaac Asimov book, and that's where the name Android comes from.

JONES: Ah, okay. I didn't know that. [. . .]

ELETR: The third company is a biotechnology company in Strasbourg, France, which is a GPCR [G-protein-coupled receptors] Company, which has a technology for screening very rapidly the pharmaceutical companies' library of compound against GPCRs.

JONES: Okay, so everything is focused on taking advantage of—

ELETR: Techniques.

JONES: Yes. Thank you, Sam.

ELETR: You're welcome. [. . .]

[END OF AUDIO, FILE 1.1]

[END OF INTERVIEW]

INTERVIEWEE: **Sam Eletr**

INTERVIEWER: **Mark Jones**

LOCATION: **Kensington, California**

DATE: **15 May 2014**

JONES: [. . .] So you were following what was going on there or…

ELETR: Which was difficult mostly.

JONES: Yeah, yeah.

ELETR: I was very close to many of the people there.

JONES: Sure.

ELETR: As a matter of fact, the company had just started here in California in August a year ago, a year-and-a-half ago. It was two Applied Biosystems veterans—

JONES: Who was that?

ELETR: An electrical engineer called George Lugar and a software engineer called Will. Another engineer who happens to be the son of another engineer who started Applied Biosystems. I've maintained good contacts with the people I've worked with. I came back as a consultant and that was about the time when the board of Applied had decided to sell the company to Perkin & Elmer.

JONES: You knew that was in the works when—

ELETR: I knew it was being discussed. I didn't know the details or anything like that.

JONES: What was your feeling about it? Did you think that was the right thing to do, a good deal to make for the company or—

ELETR: It was neither here nor there. That's what the board thought was the best thing to do and André was not against it so—

JONES: Who was leading the board at that time?

ELETR: I have no idea. I can't remember. The leadership of the board of Applied Biosystems has always been the CEO. There was no board member who was really . . .

JONES: You were leading the board when you were directing traffic—

ELETR: It wasn't a question of leading. I spent a lot of time off board meetings with individual board members to keep them up-to-date and then some board members I saw a couple of times a week and some I saw a couple times a month in between board meetings. If we're on the phone every now and then, if something came up and I felt that this person might be able to offer good advice—

JONES: Yeah, I don't know if we covered it the first time but who was really active or who did you rely on a lot for help on the board?

ELETR: I spent most of my time keeping the board away from the company.

JONES: Yeah, I remember you did mention that.

ELETR: I acted as a buffer between the board and the company, and I didn't—board members were not allowed—I shouldn't say allowed; it never came up. I never had to veto anything, I never . . . the board members never came and walked around. Things were actually with the company was through me.

JONES: And that's the way you want it to happen?

ELETR: That's the way we work.

JONES: Yeah, and it worked.

ELETR: They were comfortable, I was comfortable, and so it worked. The way I view the board's role, it may not be true in all situations but in the kind of situation we have when we were starting fresh. Primarily with people that I had selected. Every employee in the company was an employee I had selected. I knew the employee better than any board member would know them because I had selected them. They were people I had either worked with before or had interviewed extensively and felt comfortable with.

The board knew that and they recognized that they never had any surprises. They never found out something that I hadn't told them before, so in that context they never had to act as a board. There was a never vote taken where one board member disagreed and others agreed, or I forced an issue or anything like that. It was all pretty much open. Formally the board formed because it had to act as a board and approve things, but the approval came as a result of mutual personal interactions that **<T: 05 min>** all converged.

JONES: Yeah. The fact that all projects were successful, all the important projects were successful and the company's making progress, that made it easy to maintain?

ELETR: From the creation of the company I should have somewhere . . . . I think it's one sheet of paper that outlined what the company was willing to do before any of its board members put any money or finance into it initially, the see money. It had on it listed four instruments, and these four instruments went to market.

JONES: On schedule, yeah.

ELETR: Some ahead of schedule.

JONES: Yeah, so the board, the composition of the board, is pretty much the same? André thinks it's a good idea to—

ELETR: I really do not know how André interacted with the board; you'd have to ask him. When I left, I had a serious health problem and I was away, out of contact with the everyday activities for I don't remember how long, but for a considerable amount of time until I felt better. They talked with André and he said, "You know we're about to do this merger and the sale to PerkinElmer and if you want to come and help with . . ." I can't remember exactly the

context of why but at the time it was basically that there was a group within Applied Biosystems that PerkinElmer really had no interest in and the idea was, well, let's spin that group off as a separate company.

JONES: You went back expressly for that purpose, to work on that?

ELETR: I can't remember. I can't honestly say whether—it was a component—I don't think it was. I went back because I was interested in that particular aspect, and that particular aspect was at the time . . . there was strong interest everywhere and sense.

JONES: Who was working on it?

ELETR: Well, Gilead [Sciences, Incorporated] had started to do that.

JONES: Yeah, Gilead did. I meant at Applied Biosystems?

ELETR: Applied Biosystems started doing that before Gilead or about the same time. I don't know. But there was a group at Applied Biosystems that had developed . . . . I remember the first DNA synthesizer that was successful was Applied Biosystems. Applied Biosystems—

JONES: They had the chemistry expertise?

ELETR: Yeah, they had the chemistry expertise. The people who ran the group had a vision that perhaps that expertise could be used to make large quantities of synthetic DNA that might be used as drugs. Our system wasn't in business in time to develop drugs. All it was shooting for was enabling a large quantity of synthetic DNA to be made, and so that was an expertise that PerkinElmer were not interested in.

JONES: My understanding—and I forget who put it to me—but the idea for the merger, a big part of the merger, was to get access to PCR [polymerase chain reaction]. Is that your recollection?

ELETR: Well, PCR was an important component of the IP [intellectual property] at Applied Biosystems.

JONES: Yeah. So, they're related, right? They're working with the DNA chemistry and PCR? I mean the same group would have the interest in . . .

ELETR: Not necessarily, to manufacture synthetic DNA does not use PCR. The use of PCR is for diagnostic applications or sequencing.

JONES: This group wanted to develop antisense drugs, wanted to become a drug—

ELETR: No. They wanted to manufacture large-scale quantities **<T: 10 min>** of DNA, of synthetic DNA molecules that could be used as antisense. If antisense was successful . . . . I think that the motivation of the individual behind it was to provide the quantities to anybody who wanted them.

JONES: To be a supplier to that?

ELETR: To be suppliers, yes. Applied Biosystems had no ambition to be other than a supplier of tools, and this was one tool.

JONES: Who was the main person there, in that group?

ELETR: There were two people, one person who had joined us just a short time before I left. I can't remember how long it was. His name was Jerry, Gerald Zon, and the other one, who had in fact led the DNA synthesizer biochemistry work at Applied Biosystems, and that was Tim Geiser. Jerry and Tim were working with this large-scale production and plans how to make it and so on.

JONES: Yeah. PerkinElmer had no interest in—

ELETR: I never had any direct interaction with PerkinElmer so you're going to have to ask somebody else. The way I saw it at the time was this way: if in fact PerkinElmer had no interest in that large-scale synthesis of DNA, why give it to them? The price that they were going to pay for Applied Biosystems would be the same whether that was in it or not. My reasons—that's again from my perspective, again—I didn't have any direct communication with the board or anything like that—is that if Applied Biosystems would spin off that technology, together with *x*

millions of dollars—I can't remember how much it was—the price of the merger of PerkinElmer would not be affected anyway.

JONES: Were there any other pieces of the company that were identified in the same way as maybe not essential to the merger?

ELETR: That was the one. We spun off a company called Lynx Therapeutics.

JONES: So that's how Lynx started?

ELETR: That's how Lynx started; however, I wasn't comfortable. For lack of availability for anyone else to lead it, they asked me if I would. I said, fine, so we formed Lynx Therapeutics but not having any pharmaceutical experience or any firsthand knowledge of what the antisense technology was going to do, or would say, or how would we finance it and so on. I said to myself, "I'm going to need some help to make that happen." The help that I sought and was able to get in the form of two directors at Lynx. One was Sydney Brenner and the other one was Bill [William J.] Rutter.

JONES: I didn't realize that Bill Rutter was involved.

ELETR: Yeah.

JONES: Tell me about each. Had you known Sydney Brenner before?

ELETR: Sydney Brenner, I met before Applied Biosystems was financed because I was sent to the Rothschild's Group in London to seek money for the round of financing for Applied Biosystems. They said, "Lord Rothschild is not here today to see you but in any event, he really doesn't do anything in biotechnology unless Sydney Brenner tells him it's okay. I want you to go and see Sydney Brenner first and then you may come back and shake Lord Rothschild's hand if Sydney Brenner agrees." I went, **<T: 15 min>** took the train, went to Cambridge, and met Sydney for the first time, where I had no idea who he was. I met him, explained what I thought could be done, and at that time it was just the first product at Applied Biosystems, it was the protein sequencer.

I explained to him how I thought that the very corrosive chemistry could be alternated if one designed the valves properly, so on and so forth. He nodded two or three times, and he must have given the green light to the Rothschild Group, who indicated then they could be in the

round. Because Sydney became a quarterly or biyearly—I don't know, I don't remember—but quarterly visitor to Applied Biosystems, to report to Rothschild. By the way, I never got to shake Lord Rothschild's hand. [laughter] Anyway, and so—

JONES: So he would report on technical progress?

ELETR: I don't know what he would report on. [laughter] He came, he visited, he saw, he didn't conquer, but he reported.

JONES: But he came and when he was talking to you, he was asking technical questions on this instead of the business questions?

ELETR: There is no such thing as business questions. It's basically questions as to which kind of scientist would like what features and what features they should worry about it.

JONES: Commercial questions, yeah.

ELETR: Yeah, and they're not commercial in the sense of is it worth paying that much for it or not paying. These questions never arose. The question was is it worthwhile to do from a scientific perspective? That's the kind of advice he provided.

JONES: And Jim Blair, was he—

ELETR: He was the contact for Rothschild. He used to work for Rothschild.

JONES: And he was on the board? Was Blair on the board?

ELETR: He was. Blair was on the board because he represented the Rothschild investment at Applied Biosystems. It was indirectly through Blair that I went and met Sydney Brenner and . . . shall I make another coffee?

JONES: I'm fine, thanks.

ELETR: Okay. That's how Lynx got started. I do not recall if Chiron [Corporation] in some money; I think they put in some, but I can't remember.

JONES: Had you known Bill Rutter before?

ELETR: I got to know Bill Rutter in the course of building up Applied Biosystems because we used to meet at the biotechnology gatherings in the Bay Area, both Ed [Edward E.] Penhoet and Bill Rutter, both would be there. Ed Penhoet was usually the speaker; Bill Rutter was always in the audience. I got to meet Bill and Bill is a very—you know him, I mean, he's a fantastic guy. He keeps in the background, but he really is the blood of things. I got to know him. When the issue of Lynx came up, I went to see him.

I said, "I'd like your advice. Do you think this is worth it?" He looked at some of the DNA synthesis stuff that we were able to do on a larger scale. He was somewhat interested in antisense at the time; it probably was worth a gamble for him just to be present if it worked and not.

JONES: The synthesis techniques, this was innovative at the time, nobody else was doing it? Got the—

ELETR: There were a lot of people doing DNA synthesis. I don't think that the quantity at which we could do it at the time had yet been matched by anybody.

JONES: Yeah, what enabled you to do it?

ELETR: You'll have to ask Jerry or Tim. I think Tim would probably love to talk about it; he's very proud of what he did then and is feeling very sorry that it didn't get applied, but that's another story.

JONES: They were happy to have, Jerry **<T: 20 min>** and Tim were happy to have Sydney Brenner and Bill Rutter involved?

ELETR: Surely a project they were working on that had the names of Bill Rutter and Sydney Brenner associated with it was a positive. I don't think anything beyond that; Bill Rutter never discussed science and technology with him and neither did Sydney Brenner.

JONES: Is that the extent of their roles and their kind of advisory board symbolic presence?

ELETR: They were basically, from my perspective, reassurance that I wasn't overlooking something silly. To the extent that I kept them up-to-date as to what we were doing, if they didn't respond we can continue, but they never stepped in and said you're doing something crazy.

JONES: Right, okay, so how did it progress? You got started; the idea was, I guess, everybody's here in the Bay Area so the idea is it should be here?

ELETR: What idea?

JONES: To have the company here in the Bay Area.

ELETR: It was in the Bay Area.

JONES: Yeah, naturally.

ELETR: We rented space across the bay, and we worked and got started. Then we tried, and I just remember how it came about . . . . Jerry used to be at NIH [National Institutes of Health] before he joined us and he had some contacts who helped—I may be saying the wrong things here. You'll have to talk to Jerry to clarify. I think it was through Jerry's contacts that we got into a clinical trial of the efficacy of the antisense approach in a particular situation, and Jerry managed to get a series of clinical trials ongoing in Argentina with the idea that we would—

JONES: You would supply the DNA?

ELETR: We would supply the antisense compounds for a particular target, which some of Jerry's contacts had shown in-vitro that they were active against certain genes implicated in restenosis. We did a trial in Argentina, and nothing came of it, and by that time Lynx needed more money and Sydney had invented a new way of doing sequencing, so I did a—

JONES: Which was also dependent on synthesis?

ELETR: No. Nothing to do with synthesis. Sydney had invented a new way that was the origin of massively parallel sequencing. All the new-gen sequencing right now is just amplifying what Sydney had invented at Lynx. Sydney had invented this thing, and at the time, I had to make a very difficult decision. I couldn't raise money for the antisense because the clinical trial did not provide enough substance to.

JONES: Right, and the dates are . . . this is early nineties at this point, yeah? Ninety-one, '92?

ELETR: I think the clinical trials were later than that. Yeah, Lynx got started in the early nineties, but they didn't get into the clinical trials until a few years later.

JONES: Right, so at the same time, companies like Gilead that had started antisense, they hadn't gotten anywhere in the clinic either?

ELETR: They claimed at the time . . . it was big claims like what we had now. But eventually it didn't turn out. I'm cautious by nature and when I began to think that there was nothing really to hang your hat on there, I said, "Let's switch."

JONES: And that was disappointing for Tim?

ELETR: Of course, it was disappointing for Tim and Jerry. Probably Tim took it much more personally than Jerry. I think so maybe. **<T: 25 min>** We, meaning the board of Lynx, decided to put more resources on demonstrating the large-scale sequencing that Sydney proposed.

JONES: How did you have a sense that this could be revolutionary? I mean, you knew the sequencing business inside and out, you basically invented that, so . . .

ELETR: I didn't invent anything.

JONES: Applied Biosystems.

ELETR: Yeah. We demonstrated that it was possible to sequence half a million templates on the data sheet. We got a contract from DuPont agricultural labs to do that for them commercially and we did. However, there was a key element in getting that technology to work that really could not be commercialized. It was very difficult. It was based on mounting those templates

that you wanted the sequence on as many beads, and the process of mounting the templates on the beads required some culling of the properly latent beads from the ones that were not properly latent. Which meant that we had to use—

JONES: Is that a chemical process you're talking—

ELETR: A chemical process, yes. Biochemical processes. But we had to use very expensive self-sorting equipment to pull out the beads that had properly acquired templates from the beads that hadn't. We learned how to do it, we could do it, but we couldn't expect the customer of ours to do it.

JONES: I see.

ELETR: While this was going on, because of Sydney and his acquaintances, I got approached from one of those acquaintances who was involved in a company in Cambridge called Solexa. That person invited me to join Solexa to help them because they had a very sensitive way of identifying DNA fragments that had been appropriately fluorescently tagged. But there were some problems with the use of the chemistry that needed attention. They asked me to join the board of Solexa—

JONES: Who was it that you spoke with initially?

ELETR: I think he was the grandson of Lord Rothschild, and Tom [Thomas] Daniel was his name. Tom asked me to join the board of Solexa, and I agreed to join the board of Solexa, which was no conflict between what we did and what they did. Very quickly I realized [. . .] Very quickly I realized as did also the other people at Solexa I was working with that there was a particular chemistry that had been spun off from Serono [Incorporated] in Switzerland that could, depending on how it was applied, either solve Applied Biosystems's quandary of dealing with this multitude **<T: 30 min>** of beads or solve the other quandary—

JONES: You mean Lynx's quandary? You mean Lynx's quandary.

ELETR: Lynx's quandary with the beads. Or solve Solexa's quandary with some of the inefficiencies of its chemistry.

JONES: Do you know the origins of that technology at Serono or what—

ELETR: Yeah, I know exactly what their technology is. It's irrelevant to this story. I was the Director of Applied of Lynx, and I was the Director of Solexa. I made it clear to my colleagues on both sides that there was this technology that could help this quandary or help that quandary and therefore, would you please talk to these people and see if you can license it because it's available for licensing?

JONES: But that could have turned into a competitive situation?

ELETR: No. No, it could not. It needed either one or the other. No, it needed both in order for something to really happen with it. It was in the back of my mind was complementarity of the Solexa technology and the Lynx technology, both facilitated by this other thing, would really create something big. I encouraged both companies to try and do a deal with that one. They both did and in the process of doing it realized it's better; that's how Lynx and Solexa got together with that technology, and that's how Illumina Sequencing was born.

JONES: Right, yeah, so you saw everybody involved and to see that this is the way to commercialize massively parallels—

ELETR: They needed both, so Solexa didn't have the instrumentation expertise that Lynx had, and Lynx is in some technical expertise very good and half a million templates at the time, and a few million soon, but that bead issue had to be got out of the way.

JONES: Let me ask you. At this time you're working, this going on in the mid-nineties, I suppose, and you were very close with a lot of people from Applied Biosystems, you maintained those relationships but now you're competing with them, yeah?

ELETR: We weren't competing with them.

JONES: Well, they're—

ELETR: Applied Biosystems is a shareholder of Lynx.

JONES: Oh, I didn't. Yeah, that's . . . yeah, okay, that's right.

ELETR: It's part of Lynx in their technical affairs. They also have options on many more, which they never exercised.

JONES: What about competition in terms of the technology?

ELETR: The technology was disclosed to my Mike Hunkapiller, who decided it wasn't good enough for him.

JONES: Is that right?

ELETR: Yes. Everything was done above board. Everybody knew what we had, and everybody knew that it was I was the director of this one, and they didn't want to do it; they didn't want to do it.

JONES: Did you say to him, "Mike, this is really good, you should . . ."

ELETR: I don't say anything to anybody. I just say, "This is what we've got; I think it's going to work. Are you interested?" Not just Mike. There were some of the others too.

JONES: Sure, sure. When you presented it to them, presumably you're presenting it as something you think is worthy of their consideration, something that they might want to—

ELETR: If they really want to buy, they can make me an offer.

JONES: Yeah, okay, but they didn't.

ELETR: Make me an offer.

JONES: Okay, so you put the two together?

ELETR: I didn't put the two together. The boards agreed to put them together, but that agreement came as a result of both companies independently talking to each other. I was out of it by then; I made no money out of this by the way.

JONES: Really?

ELETR: No. I just brought them together, and I went on to do something else.

JONES: Yeah, okay. When that ended, you decided at that point that you said, "Sydney, I'm going to go do something else?" He was still with—

ELETR: No, no, no, no. **<T: 35 min>** It was . . . something else was a company that we have in Cambridge called Population Genetics.

JONES: Oh, this is with Sydney too?

ELETR: Yes.

JONES: Yeah, okay, I'm sorry, yeah.

ELETR: We just decided to go beyond what bringing those two together would do anyway.

JONES: How did that come about? When did you see this and when did this start to take shape?

ELETR: I can't remember the dates. It began to take shape after. The dynamics of groups of scientists working together, very often if they deviate from the vision of anyone in the group, if that dynamic engages the majority of the group and you're not comfortable with it, the best thing to do is to let it go their way because—

JONES: Sure. Was there something that you weren't comfortable with?

ELETR: I'll answer you indirectly. I mentioned earlier that at Applied Biosystems my primary role in terms of dealing with the board was to make sure that they did not interfere with the function of the company. If I'm going to be responsible for something, I don't want the majority vote of people removed from the heart to decide what's correct or what's right or wrong. They may be right, they may be wrong, but I have no control so why should I put myself in there.

JONES: Yeah, right, I understand, but you saw the potential for this?

ELETR: Of course, there was—

JONES: I mean, what Illumina has made out of it, yeah.

ELETR: Well, of course.

JONES: Did it have anything to do with the technical direction or to do with the technology?

ELETR: Obviously, it was. It was the bringing together of two technologies that needed that both of them to work—

JONES: No, right, but then to use it and to develop it—

ELETR: There was no question that the sequencing of the human genome was not the end of the story. A lot of people said, "Well, now the sequence of the human genome . . . we know the sequence, now we know everything." Bullshit. It was going to be much more sequencing and then will still be much more sequencing. Now, sequencing has become a commodity because of some of this. In fact, one of the big problems of sequencing today is not the actual sequencing; it's the type of operation for sequencing. That's what the cost is. That's why I developed a manual robot that would facilitate . . .

JONES: Okay, designed specifically for that? Okay.

ELETR: Not specifically but it was one of the drivers; it was one of the drivers.

JONES: Good. You saw this developing and I'm just trying— you don't have to answer if you don't . . . but you didn't like the direction they were going?

ELETR: It wasn't I didn't like. It wasn't something . . .

JONES: Or it was your role?

ELETR: No, it was not that either. The reason I'm hesitating or being careful is because I don't want for anything I say to be taken out of context to mean something about me.

JONES: Yeah, I understand, and that's fine. Of course, I just want to remind you that we won't do anything with any of this information without your permission.

ELETR: Fair enough, but I'm trying to explain it. I want to explain it to you. <**T: 40 min>** The main reason for the success of Applied Biosystems has nothing to do with any managerial qualities that I might have or any intellectual or any technological input that I might have provided. I'm a physicist by training, I did not know anything. I did not know that people even sequenced proteins or DNA when I started the company. All I knew was an instrument was needed for alternative chemistry that some bright people had developed the right chemistry; some others had made attempts at alternating that chemistry and had told me why they felt they had failed and I attacked those problems from a mechanical, physical perspective.

But at the same time, I don't think I would have, the company would have succeeded at all if it weren't for the fact that I picked people who I knew were going to work well together. The cultural differences between Cambridge and Silicon Valley and the biotechnology coming out of Switzerland at Sereno to my mind was going to be a hell of an obstacle I didn't want to bother with. Some of those people were not people I would have picked out to work with, not because of any particular—

JONES: Maybe they're fine, but if you put them together, it's not going to work?

ELETR: Or maybe the way they look at things isn't the way I do. How am I going to be comfortable telling them or advising them to do this or that? That's basically it.

JONES: So you decide, okay, I'm not going to go with that for . . . great idea, good luck—

ELETR: Yeah, I moved on to something else. At the time I had already started, gotten involved with another company.

JONES: Not Population Genetics?

ELETR: No, no. It was a company I had; I was on the board of the company that failed.

JONES: Where was it located?

ELETR: In Strasbourg.

JONES: Okay. Where you have another company today?

ELETR: The company today in Strasbourg is a descendant of the one that failed. I was asked to join the board of the one that failed more as a ceremonial thing than because of any expertise I brought to it. Put people on the board because they were going to have a name on it. The company failed or couldn't raise more money, or the venture capitalist behind it felt it was going in a different direction—whatever. Whatever the reasons were. There was a little bit of a nugget of technology there that I felt could be the seed of another company. I offered to put some money back into that and one or two other of the VCs in the old company felt comfortable in doing the same thing, and that's how the current company in Strasbourg was born. I was ex-chairman of the board and then a few weeks ago when I resigned to make room for someone out of the pharmaceutical industry who could better lead than I can.

JONES: I see, and that was a molecular biology company from the beginning?

ELETR: Yes. It's a GPCR company, identification and GPCR targets. It now has contracts with two Japanese companies, Eli Lilly [and Company] and in discussions with Pfizer [Incorporated]. You know, so it has a tool that other pharma companies could use. I was putting my energies into that with people I had selected to work with.

JONES: Yeah, while the first company failed . . . you got involved with that company prior to the merger between Solexa and Lynx?

ELETR: I can't remember the dates. I have to look at my calendar.

JONES: Yeah, but really it was after—

ELETR: It was after Solexa.

JONES: When you started to devote your time to this? Yeah, and the first company had failed at that time or had not failed?

ELETR: No, it had just started. I was asked to go on its board.

JONES: And why did it fail?

ELETR: Because it had **<T: 45 min>** undertaken to go after a particular pharmaceutical target where they thought that they had already been on the market and the intent was to repurpose that drug in the market, and it turned out that the market size and the aspect of intellectual property because the compound was already on the market did not offer enough assurance to a large pharmaceutical company that it's worth marketing. That's basically it.

JONES: Good idea? It could have worked.

ELETR: It was a good idea. I mean, it was a good idea. Whether it could have worked or not I'm not qualified to judge because the pharmaceutical industry—

JONES: Is risky business, yeah.

ELETR: Yeah, but the reason I was asked to join this board is very simple. It was based on the work of a professor at the University of Paris in d'Orsay, [France], who was my classmate in elementary school. [laughter] And the venture capitalist who was funding that work is someone whom I had met here in Berkeley many years ago and he was doing his—he's a Frenchman—he was doing his postdoc study in the seventies in Berkeley, and he asked me as a favor to join my former schoolmate. Anyway . . .

JONES: Yeah, I get it, yeah.

ELETR: It had nothing to do with rationality.

JONES: Many important things happen that way. Okay, so you're doing that and then so Population Genetics comes sometime later?

ELETR: Yeah.

JONES: Okay, so maybe were in France now, you're back living in France?

ELETR: I'm commuting. The reason we're all alone here is that my wife is in South Africa. She's of South African origin and so we spend a lot of time in South Africa, we spend time in France, in Mallorca, [Spain], as well spend time here when the weather is nice here.

JONES: It's hot now.

ELETR: Are you uncomfortable? We can stop.

JONES: No, no, I'm fine, but no, it's very hot, unusually hot.

ELETR: Yeah, but if you're uncomfortable, we can move inside.

JONES: No, I'm fine.

ELETR: Anyway, when people ask me where I live, I say, "United Airlines."

JONES: Yeah, yeah.

ELETR: The reason we started this is in Cambridge is because Sydney had a former student of his that he thought would be qualified to run the biochemistry.

JONES: Who was that?

ELETR: It was . . .

JONES: That's okay, we can look it up. Yeah, no, I know how it is with names.

ELETR: It's on the tip of my tongue, but I cannot recall. Anyway, so I met the gentleman, I liked him, and we started the company Population Genetics with the financial help—let's put it this way after the Lynx-Solexa thing—

JONES: Yeah, did Sydney Brenner stay involved with that?

ELETR: No. No, Sydney said, "We've proven that we can do a half million things that company is going to make it easy for everybody to do. Our job is done anyway." Move onto something else.

Something else, something that Sydney, a former student of his and I decided to explore indirectly. We hired one of Sydney's former students. Housed them in some laboratory somewhere to prove that the basic idea may work and created a limited liability company called Compass Genetics. **<T: 50 min>** Then when we decided to create the company in Cambridge, the Wellcome Trust took in the money for the company in Cambridge, and we contributed the technology from Compass Genetics, and we called it Population Genetics. Population Genetics licensed Compass Genetics that Sydney, Philip Hedrick and I had ceded. Got started with Population Genetics and we hired some people. Long story. Population Genetics developed a number of technologies that enabled people to look at the population of genomes simultaneously. Instead of having to sequence every genome in a population, you could put all the DNA together and obtain sequencing information in one sample from that population, without having to lose the identity of which genome came from whom.

JONES: Yeah, that's a pretty good trick.

ELETR: Yeah, and that trick has been licensed to two companies. I think it's public information. I'll double-check. [. . .] It's New England Biolabs [Incorporated] and Agilent. There's a third technology that remains in Population Genetics, which we're now trying to finance. It's a diagnostic type target. That's the history of that. While I'm working on this and because of the awareness that I had of the importance of sample preparation and sequencing, I decided to go ahead and start that robotic company, which I did with a group of scientists and engineers of another company that failed on whose board I was.

JONES: And that—

ELETR: That was SpinX.

JONES: And that's here?

ELETR: No.

JONES: No, this is in Strasbourg.

ELETR: That's in Geneva.

JONES: You're in Geneva, okay. I'm a little confused; you got lots going on in different places. You've had a lot of experience doing business in different places—in Europe, in England, in the United States. What are your opinions? Or what have you observed about the differences?

ELETR: I've observed that there's about the same proportion of smart people everywhere.

JONES: Sure, yeah.

ELETR: However, the constraints imposed by society on the manner in how free people think they are affects very much how the work is done.

JONES: So it's safe to say there's more freedom here or perception of more freedom?

ELETR: I don't know how best to describe that. I'll give you a couple of anecdotes. Before Applied Biosystems when I was at Hewlett-Packard at the time, and because I had been hired in a context where there was some remote involvement from Bill Hewlett himself. I sent into his office a letter asking why the personnel office had rejected my application, which I thought they should have applied. His secretary had returned back and said, "Mr. Hewlett would like to meet." [. . .] I met so-and-so and got a job there. Eight, nine years later when I left Hewlett-Packard to start Applied Bio, I felt I should go and explain why or apologize why—whatever.

I asked permission to see Mr. Hewlett, and he looked at me and he said, "What have you got to lose? The worst that can happen is you come back here." [laughter]

JONES: That's very nice, yeah, that's good.

ELETR: That's an observation that no European manager would make.

JONES: Yeah, yeah. **<T: 55 min>** So it's a little bit harder to do things?

ELETR: I went to France. I went back to France for a postdoc. I got my PhD there and I got my PhD doing spectroscopy and magnetic resolution—things like that. Then when I went back to France, I got interested in trying to do that kind of spectroscopy on biological systems, on cell membranes, for example, and the boss at the lab said, "You're a physicist; leave the biology to biologists."

JONES: It's a little bit more open here for doing cross-disciplinary, trans-disciplinary work that kind of—

ELETR: It's particularly true in California; I don't know how it is in the rest of the United States.

JONES: Well, there are other places, certainly in Boston, Cambridge, same kind of environment, I think but, yeah. Where do you see Population Genetics has these technologies now, one is with Agilent, one's with Biolabs and if DNA sequencing makes it to the clinic, becomes affordable, then these technologies will really take off?

ELETR: Well, no, these technologies . . . . I really . . . . I can't answer. I don't know.

JONES: Yeah. On the one hand, you can sequence an individual genome.

ELETR: So what?

JONES: That's it so you have now if you can do this you can learn a lot about what's the relationship between this individual genome and a larger population, yeah? That's worth knowing, yeah?

ELETR: What you asked before, and I'm not going to try to . . . . I think it's a question that's worth asking the several experts that you have access to that I don't have access to. How important to all the possible diseases or biological disorders is just the human genome?

JONES: Very few, maybe whether you have a single gene mutation that causes some condition, even there are a few of those, right, they've identified?

ELETR: Sequencing the human genome individually is not going to give you very much information.

JONES: No, that's right.

ELETR: You've answered the question.

JONES: Yeah, but so you have the technology where you can look at patterns that are—

ELETR: Yeah, but of those patterns there are going to be defined differences, how many of those differences are due to the differences in the human genome—

JONES: Or environment or . . . yeah.

ELETR: . . . or are due to infections of the organism by other genomes?

JONES: You can identify that, right?

ELETR: Yeah, but you still do not know which of that is associated with—

JONES: It's very complicated.

ELETR: It's very complicated, it's just so . . . and I do not know enough about where things stand to comment on that. The things that we're focusing on right now, at Population Genetics right now, one of the technologies that we've developed will enable you . . . well, let me back up. Most assays, diagnostic assays have to use PCR to have enough material to sequence. But PCR makes errors **<T: 60 min>** and when you sequence a sample you do not know which of these errors are due to the PCR process and which are mutations that existed before your PCR. Population Genetics's technology enables you when you find a suspected mutation; it tells you whether it comes from a PCR product or whether it comes from the original molecule before it was PCR.

JONES: How does it distinguish?

ELETR: That's the trick. To distinguish that, because we are able to tag the original DNA before its PCR . . .

JONES: How are you tagging it?

ELETR: With DNA and in a clever way that is not affected by the PCR so that in the products that come later, if there's anywhere on any fragment anywhere there's a suspected mutation, I can go and look: does it have an individual tag or is it copied? If it's a copy, unsuspicious, I'll put it aside. If it's the original tag, I know exactly what is.

JONES: This is the technology that Population Genetics still holds?

ELETR: This is the one that it still holds. For certain diseases. It's been licensed for others.

JONES: I see.

ELETR: We're holding back for infectious diseases.

JONES: Why did you select infectious disease?

ELETR: I had to select something. We had to sell something to get money to invest in something else so . . .

JONES: Yeah, well, why infectious disease rather than cancer? Well then might actually related but—

ELETR: We picked infectious disease because right now there's a very strong market for HIV [human immunodeficiency virus] and HPV [human papillomavirus], which suffer from the problem of knowing whether the mutations you see are induced by PCR or not.

JONES: Yeah, and the technologies that you license to New England Biolabs and to Agilent, those have to do with the . . .

ELETR: I don't know the details.

JONES: Yeah, okay. Is Sydney Brenner still involved in the company?

ELETR: Yeah, yeah, he's a shareholder. He's an advisor. He's not on the board; he never was.

JONES: Do you see him occasionally?

ELETR: Not as often as. His health—

JONES: It's the late eighties by now?

ELETR: Yeah, yeah, and his health is failing him.

JONES: Yeah, so active how are you in this business—still full-time engagement with these enterprises for you personally?

ELETR: It's hard to do anything part-time. I mean, obviously I'm doing part of my time in each one but . . . . I'm in the process of considering another one too.

JONES: Really?

ELETR: Yeah.

JONES: Very good. You mentioned before that you were working on some kind of memoir or some kind of biographical account?

ELETR: Yeah, I'm still working on it when I find the time.

JONES: Good. When you have some of that together, we'd be happy to read it for you to help you with that, and we hope that when we write up our stuff . . . well, we're working on a history of commercial biotechnology going back to the late seventies, early eighties.

ELETR: Do you want some more juice?

JONES: I'm fine, thanks. Applied Biosystems would be a good part of that so we'll write that up and I will send you that part for your critical review. That would be good. We'll also give it to André.

ELETR: Sure, André was the first person I involved in Applied Biosystems.

JONES: We've been able to talk to a number of people from Applied Biosystems. I haven't been able to get to Mike Hunkapiller.

ELETR: Well, I think Mike has . . . . I don't know. He's—

JONES: I think he's naturally reserved and—

ELETR: He's naturally reserved and also—

JONES: He's busy. [laughter]

ELETR: <T: 65 min> He has not gotten over yet—in spite of all his achievements—he hasn't gotten over the fact that he was once a student of Leroy Hood.

JONES: He feels like there's competition there?

ELETR: Not competition. It's just he feels like—

JONES: He's still in the shadow somehow?

ELETR: He's still in the shadows even though it was he who did much the . . . yeah, that, you know—it's a very hard issue to define the broader line between where credit is due and where credit is shared and you know how difficult that is.

JONES: Yes, yes, well, we just did a story on Leroy Hood; be happy to do one on Mike Hunkapiller. I haven't been able to reach him yet; we'll keep trying.

ELETR: I mean, look, there's no reason why you shouldn't**.**

JONES: Yeah, no, he's an important part of the history, done a lot of important things so . . .

ELETR: I know another person. I don't know if you've . . . he may have retired now—it's hard to keep up with the ages of people—but a former student of Leroy Hood, he was a professor at the University of Wisconsin . . .

JONES: Smith?

ELETR: I know it's Smith.

JONES: Yeah.

ELETR: Have you talked to him?

JONES: No, we do have an oral history with him that was done at the Smithsonian. I haven't talked to him personally but, yeah, that would be good.

ELETR: He was at the origin of the DNA sequencing with Mike Hunkapiller.

JONES: Right, yeah.

ELETR: The initial patent, the initial work. I don't know if you got it in the patent, but the initial work with—I'm not sure if was the patent with the fluorescent detection—with one tag was Lloyd.

JONES: He did the laser detection?

ELETR: No, no, he's the first one who showed that one could do it with gel electrophoresis with instead of a radioactive compound, a fluorescent compound, but we couldn't go beyond that because getting four different colors turned out to be very difficult to do. That was not at Applied. That was done at Caltech. Lloyd was the origin of it and it was the chemists that I hired at Applied later that pursued that work. He could probably give you a good perspective on that.

JONES: Yeah, I'll try to reach him, yeah. We talked to some others too. I didn't personally but one of our folks talked to Bill Efcavitch. He was involved in those machines.

ELETR: He was involved in the DNA synthesis.

JONES: Yeah.

ELETR: Yeah, Bill is back in California now.

JONES: We're trying to get multiple perspectives on everything. Anything else we should add, Sam?

ELETR: You tell me. I mean, I—

JONES: Okay, if we have any questions we'll get back to you.

ELETR: No, I think there's one thing I felt very uncomfortable after that volunteering for that video thing at the last meeting. Because I ended up hesitating a lot and I don't know how much of that you're using or not using.

JONES: I don't know. I haven't seen it. Do you want to do it again sometime?

ELETR: I would like to see it at least or see a transcript or something. The main message that I wanted to give—I've thought about it—in the context of questions—I don't remember all the questions—the main message that I wanted to give is the following. From my perspective in terms of my involvement in the creation of Applied Biosystems, chances are if Bill Bowes hadn't spent as much time with me as he did, I probably wouldn't have left Hewlett-Packard.

JONES: Yeah, that's good to know.

ELETR: That's one point I was trying to make but the questions I was being asked, "Well, did Bill Bowes understand where biotechnology was going to go?" **<T: 70 min>** I can't answer that, and I don't want to even try to answer that because chances are the answer is no. But the fact is that the point I was trying to make is that in today's VC world people like me would never start a company.

JONES: Because of the way it's changed and—

ELETR: Because of the way it's changed. If someone with an MBA comes with a series of questions to ask you and if you hesitate about all of these things, he will not sense that maybe you have the capacity to do it and you're scared like Bill did with me. And so did Moshe Alafi. The number of breakfasts I've had with Moshe; we were like this many years ago before I decided to really throw myself into Applied. I can't imagine that happening with any of the VCs that I've seen today. That's probably worth an article by itself. [. . .]

[END OF AUDIO, FILE 2.1]

[END OF INTERVIEW]