Conversazione with Earl Bakken

On December 19, 1995

At The Bakken Library and Museum, Minneapolis

David Rhees: I’d like to welcome you all here to The Bakken Library and Museum. My name is David Rhees. I’m the executive director here, and it’s a great pleasure for me to welcome you to our first conversazione. It’s an Italian word for conversation, and, in Italy, it denoted a meeting or assembly, especially in the evening, for conversation and social recreation or for discussion of some topic of art, science, or literature. So the idea is to have sort of an informal and pleasant kind of seminar atmosphere where we can bring people together who have a common interest in the history of the Minnesota medical device industry.

It’s a very distinguished history, as you know. The rise of what is often called “Medical Alley” has attracted national attention. There are many interesting stories of invention and innovation that deserve further documentation, preservation and interpretation. We here at The Bakken [Library and Museum] decided that it was an appropriate time to bring people together who have a common interest in the history of this industry. We hope to get the conversation going, to let people know who each other is, and what the various historical, interpretive and educational projects are that are going around.

At this point, I’d simply like to introduce our speaker. I’m really thrilled that Earl Bakken was willing to help kick off this seminar series. I don’t really need to say much about Earl Bakken. He is the co-founder of Medtronic, in 1949, and we’re also very, very grateful that he has an interest in the history of this industry and this area of science and medicine. In the late 1960s, he began, with the aid of Dennis Stillings, to collect scientific instruments and manuscripts and rare books on the subject of the history of electricity and its medical applications.

The Bakken Library and Museum was formerly incorporated as a nonprofit organization in 1975, and since that time we not only have expanded our collections to the point where we have about 10,000 very fine rare books and several thousand scientific instruments, but we also have numerous educational programs trying, as it were, to get the next generation of inventors and Earl Bakkens launched on their path.

So at this point I’d like to turn things over to Earl Bakken, who’s going to speak on “Before the Pacemaker: The Early Years of Medtronic, 1949-1957.”

Earl Bakken: Thank you very much, David, and welcome to The Bakken. David mentioned several things about The Bakken, and if you haven’t had the opportunity to
tour The Bakken, you really should do that. Particularly since most of you here are scholars in one sense or another and come here and get the tour and go up in the vault to see those 10,000 rare medical books, that medical electricity that David talked about. It’s unique in the world, and it’s right here in Minneapolis. So we want to invite you to come back at a tour time, when it can be arranged for a tour with David or Alice Schroeder, or any of our wonderful tour people that we have here that work here.

We are excited about what this museum is today and what it can be in the future. We plan to put an addition onto this building so that we can expand our course work, our meetings, to make it a real intellectual center for Minneapolis and St. Paul. As David mentioned, this is supposed to be some sort of conversation. I’m not sure I’ll ever be able to pronounce that Italian word, but I’d like to make it a conversation. I don’t have a formal lecture prepared. I guess that isn’t what’s wanted. This isn’t necessarily—

David Rhees: Oh, no, that’s perfect.

Earl Bakken: This isn’t a seminar or to teach you something. It’s to inform you and to maybe discuss some of the things about the early days of Medtronic that got us started, see how they apply to companies that might be starting today, or might not fit today’s world. I guess the one theme that rings through everything Medtronic has done is the “ready, fire, aim” theme. So many of the things I talk about today will be things we just burst out and did, rather than analyzing them to death before attempting to do them. Obviously, not everything succeeded, but enough succeeded that we have a pretty stable company, now at the two-billion-dollar level and 11,000 employees.

I would like to talk about the period from the time we started in 1949 till the development of the first pacemaker with Walt Lillehei, who just came in the back here. And that was a “ready, fire, aim.” We just went ahead and did it, and did it in four weeks from the time Walt and I talked about the need until I delivered it to the University of Minnesota.

I think it’s maybe interesting to a lot of people that there was a history of Medtronic prior to the pacemaker. Whenever I talk to some new person, they say, “Well, how did you start your company with the pacemaker?” I didn’t start it with the pacemaker. That was after we were some eight years old before we got into pacing. So there’s a lot of history prior to the pacemaker, and it’s that period I want to talk about today, or have been asked to talk about. Then I would like to have you bring up questions or comments, anything that we can discuss to see what we did, how it compared with other companies, with your company, or however you would like to divert or go, I think we’ll work with.

It’s a little hard to just start with the organization of the company in 1949. I do need to do a little bit before that to tell you how we came to start Medtronic. I don’t know whether you got here early enough to see some of the Frankenstein exhibits in the room back there, and, of course, the Frankenstein stuff on the walls. Is that an appropriate kind of
display for a museum like ours? I think it is, because the story of Frankenstein is so important to engineering, that so often, as engineers, we create something that’s meant to be good and then it turns wrong later on. Society turns it into a monster, like nuclear energy, or bioengineering, gene therapy could turn into a monster if we don’t control it. But as engineers, we need to take responsibility for what we create, and of course that’s Mary Shelley’s theme of Frankenstein.

When I was a small child, I was always interested in electricity, and when I saw the Frankenstein movies in 1932, that’s when I became interested in electricity and life. So I kind of kept that theme throughout my life that I wanted to get into that area of building stimulation devices that would restore life or keep people alive. So, for me, the Frankenstein movies were inspirational movies. I think that’s a little part of why we have this display here, and I guess it will be here about a year before we go on to the next theme. So I invite you to investigate it some more.

As David mentioned, we have over 10,000 rare medical volumes down in our vault, but of all the volumes we have there, the most important one to me is Mary Shelley’s Frankenstein. The 1818 version of her story, one of them is in our display case there. It’s in three volumes. I invite you to look at what I think is one of our most important books. Scholarly, it may not be all that important, but David is lecturing on Frankenstein at the University [of Minnesota] and other locations, so I guess it has a lot of meaning.

Anyway, I carried that theme of interest in medical electricity through World War II and then to the University of Minnesota, and went through my bachelor’s degree there at the University and started graduate school and started going across Washington Avenue, which we’re talking a lot about now with the bioengineering school connecting the medical side to the engineering side with the new biomedical school. I started wandering over there because of my curiosity in medicine and electricity in medicine, and got acquainted with some of the people in the EKG [electrocardiogram] area and the clinical labs, and they knowing I was an electrical engineer, asked if I could repair some of their medical equipment.

That was 1949. If you can visualize that period, it was just after World War II when hospitals, clinics, and labs were starting to use some of the electronics that had been developed during World War II, and they had nobody to repair that sort of stuff. They had engineers who could repair elevators and fans and so forth, but not electronic stuff. The University was trying to get some of it repaired by going to radio shops and seeing what they could do.

One night, Palmer Hermundslie, who was—we were married to sisters. We were at a family birthday party, and we were talking about this, that I was having the opportunity to repair some of this equipment and learn about EKG machines and flame photometers and osmometers and pH meters and all the Beckman stuff of that day and all those sorts
of things. He said, “Maybe there’s a business in setting up a quality repair service for medical electronic equipment.” We didn’t analyze it. We didn’t study any market potential. We started the business.

So I quit graduate school, which was a good thing because I was telling Dave here I was just getting into advanced thermal dynamics, and there were a lot of physics students. That was bad enough, but I figured I’ve got to do something else for a while. [Laughter] So I quit graduate school, and Palmer quit his job at a lumberyard, and we set out for the business of Medtronic. We set it up in a garage.

Could I have the first slide? I don’t think you need to see a lot of detail, but this is the garage where we started the business, and I don’t know how many of your businesses started in garages. But this was a three-stall garage. It was built by the Hermundslie family during the Depression years. It was built out of a boxcar, so it was pretty solid lumber, but it had no insulation. In summer, we had to run a hose in the roof to try to get a little cooler. In winter, we practically froze in this building. But it was the first beginning of Medtronic. Actually, it was much smaller than this room. This must have three times the area, maybe twice the area of our original garage. There were two of us that started the company, and then Palmer’s mother worked for a while as the secretary.

The first month we were in business, we did a gross sales of eight dollars, and that was a service call on a centrifuge at the University of Minnesota. Now, of course, as I mentioned, we do something over two billion. This year we’re running at the rate of over two-billion dollars per year, so that’s been a fairly nice growth.

Unidentified Speaker: Is that you in the picture?

Earl Bakken: No, this picture is of the garage, but anyone who is a car buff—any car buffs here? They know of cars. Some car buff told me that those are 1934 and 1935 cars. We started Medtronic in ‘49, but this was the only picture we were ever able to find.

Unidentified Speaker: I think the one on the right is new.

Earl Bakken: Is it? Anyway, they were long before 1949. So I have no ideas whose cars they were, probably just some of the cars that the Hermundslie family was rebuilding. But, of course, it’s winter. What else would it be in Minnesota? And so those are not our cars.

As we started to grow, we moved into the garage next door. It’s about fifteen feet from this garage. Then we built between them, and then we built out in front. So we were not able to get a picture of the garage without going back and finding this old picture of the garage.
Unidentified Speaker: Where was this located?

Earl Bakken: It was located in northeast Minneapolis, right behind the Hermundslie home, 19th and Central, just off—I guess it’s Jackson, the first street, and then a block and a half off Central.

Unidentified Speaker: Is that still standing now?

Earl Bakken: No, it’s not standing. After we used it for several years, then in 1960 we went up to our first buildings up in St. Anthony, first building that we built. The building was turned over to the Minneapolis—well, first it was a printer that moved in there for a while. Then it was turned over to the Minneapolis School System, and they used it as a school away from school for students that were dropouts, and that was it for a few years. And then several years later, when the Minneapolis School Board wanted to end their use of it, they came to me and said, “What should we do with this building?” And I contemplated, “Well, what do we do with the old building? Do we bronze it? Do we move it to the new campus that we were starting out in Fridley, where we are now?”

Then I finally said, “No, not interested. Do what you can. Sell it for what it’s worth.” And I believe they sold it to somebody, but whoever bought it found out that it was completely illegal. It was too close to the property line and all sorts of other things, so they made me destroy it. It’s just an empty lot now.

But let me go to Jax’s Cafe for our lutefisk luncheon which we just had. We sometimes drive by that empty lot for old times’ sake. It used to be pretty interesting working there in Nordeast. There used to be a restaurant over on Central Avenue called the Elmwood Cafe. That compute with anybody? It used to be a nice family restaurant where you come in at noon and they’d serve you. There was no menu. They just served you the food in bowls. It was just family style, but wonderful bread and pie. We used to go over there to grocery store and scrounge for boxes that we could use for shipping. That garage where the door is out was our shipping/receiving department where Neil Heraly worked. I think many of you recognize the name of Neil Heraly. He’s on medical leave now, but still with the company. So it was an interesting period of time.

I’m not sure what order these slides are in. This is me at the garage working on some Sanborn equipment, some amplifiers. I always used to wear these plaid wool shirts. I never had coat or tie back then when we were just a few people in the garage. I had a crew cut and was much heavier at the time.

[Slide change] This was the symbol [logo] I came up with. Obviously we couldn’t afford to go to any media company or anything like that. For those that know electronic symbols, it has the capacitor and then “Medtronic” written in it, and then the caduceus is like coils and potentiometers for the sloped part of the caduceus. I thought it was pretty
neat. Later on, we had to change it as we began to get to the core media people, and they said it was too ornate. We had to go to simpler forms. We’d gone into all sorts of “M’s” until we ended up with the symbol we have today, and I assume that’s going to change here probably when we start our fiftieth anniversary.

Anyway, I thought that name Medtronic was a pretty good one when we were working on medical electronic equipment. I took the “med” from medical and “tronic” from electronic and put them together.

Roger Stuewer: When did you coin the company’s name?

Earl Bakken: Right at the beginning. It came to me one night when I was in bed. We tried to register the name back then, and we couldn’t do it because there was a small company in California that had registered their name Meditron in 1948, and they made electroencephalographs. We said there was no problem, that they should let us register our name, that there was no conflict, we weren’t in the same fields at all, but they resisted.

Finally, as we grew, we finally bought that company, and solved that. We didn’t care about gaining an electroencephalograph; we wanted the right to our name. They were just as happy because they were not doing well against Grass and some of the bigger companies in the electroencephalograph field. And so they were just as happy to get their money. We then registered our name. We’ve done a lot to protect that name over the years. Every time a company has tried to come up with a similar name, we have contested the name in court, like Medsonic, or Medtronix with an “X” on the end, all different versions that people have come up with that have Medtronic combination.

David Rhees: Were you ever sorry that you didn’t make it plural, Medtronics, because a lot of people, I notice, call it that.

Earl Bakken: That’s always a little bit irritating to me because it’s not the name. The name is Medtronic. However, we are so diverse now with branches all over the world and many different areas that we’re working in that Medtronics with an “S” is probably more proper at the moment because they certainly are plural. But we always look when we go into a hotel or something when Medtronic’s having a meeting, when they put an “S” on the name, I always insist that someone go to the hotel and get that “S” taken off, because it’s not our name. But it’s true, we’re certainly plural in our laboratories and opening more laboratories all around the world. We’re now building a big center in Switzerland to move our new headquarters, the European headquarters, to Switzerland, and research center there, the new research center in Tolochenaz. So we are very plural and we’re buying so many companies now. It’s hard to really think of us as just singular. But somehow it bothers me to use the “S.” But maybe now that I’m gone now, we may change that, too.
During that first year we were in business, 1949 to 1950, we began to service equipment for the five-state area, and that brought us in line with some of the equipment that was interesting to us, that we thought we would sell as well as repair. Some of that was the Sanborn electrocardiograph machine, which I’m sure many of you will recognize. This is the machine that I sold for Sanborn Company, which is a Boston company, later on was bought out by Hewlett-Packard and now is the medical division of Hewlett-Packard. But they made first the single-channel machine, the first photographic machines, and then the direct writer.

Down in the basement here we have a room called “The Graphic Method,” where we show all the earlier types of electrocardiograph machines, using the string galvanometers, and then mirror galvanometers, and then the direct writers of this type. So if you look at Medtronic—we started first as a service in repairing medical electronics, and then as a company for selling other people’s manufacturing equipment. So we became a manufacturers’ rep[resentative].

I can remember the days of blizzards, traveling through North Dakota and South Dakota, flying out of town several times a year making a trip out to Rapid City and out to Fargo and Bismarck, selling and repairing these Sanborn machines. So I really know what it is to get behind a truck and try to make it through the snowstorms and finally end up in some motel for the night. It’s no wonder that when I retired, my wife and I got out of here fast. Every time we come back, we get reinforcement as to why we’re living [in Hawaii.]

In the following years, the Sanborn Company came up with the two-channel machine, pre-digital, and the four-channel machine. Maybe some of you remember those machines. Maybe not, because many of you weren’t even born. I shouldn’t think you’d remember the Sanborn machines, but there are certainly some of you that remember the Sanborn equipment. We sold so much of it to the anesthesia department at the University of Minnesota, and to the surgical departments at the University of Minnesota.

It’s hard to describe those days at the University. It was so open and so easy to go over there and work with the laboratories. We didn’t even think about there being some barrier to working with the medical groups. Lillehei and his group were—we had the free run of the animal laboratories and surgery. I had my own locker in surgery for a while because I was in on some of the early open-heart work, was running the equipment, helping with the equipment in 1954 and ‘55. I think that’s so important for small companies to have that opportunity to work where the excitement is.

We worked with the farm campus. We had several projects going there. We worked with X-ray and EKG and the physics department. I don’t know where the barriers came up between industry and working with the wonderful universities at that period of time. My hope is certainly that as the biomedical engineering school develops over there at the
[University of Minnesota,] there will be an increase in opportunity to work together with the 500 biomedical engineering companies, or 450-500, I don’t know the exact number, but around that, to work with the various departments at the University that particularly work with in terms of biomedical engineering areas.

I think it’s so extremely important with this being a biomedical center—there’s more biomedical companies per population than any other state—that we have this growing great biomedical center at the University of Minnesota. For years we worked in trying to get a biomedical center. I don’t know if Walt remembers when we used to work with Dr. [Richard] Varco who was heading up for many years a committee to try to get a better biomedical engineering center. They never quite pulled it off, a few pieces of biomedical engineering around the University, but no center. And now it’s happening.

I always kind of felt bad about that, that my own school, my alma mater, didn’t have a biomedical engineering center that can compare with the best of centers around the nation. I was telling Dave here that I have over the years developed a good relationship with the biomedical engineering school at Tulane, and that’s kind of a shame, and that isn’t my school. But now it’s pretty exciting to know what’s happening and the cooperation between my team and the medical areas of the school are going to bring this all together and are bringing it together. It’s not something that’s going to be; it is happening. That’s pretty important to me.

[Slide change] This was our employee complement when we were in the garage. We had added a little bit to the garage. I imagine this was about ‘52 or ‘53, sometime in there. This was our entire population of the company, which now, as I mentioned, is 11,000.

Unidentified Speaker: Earl, are you in there?

Earl Bakken: Yes. You notice this big fat character with the crew cut? That’s me. There are a lot of people, for those of you who are from Medtronic, you know John Bravis back here, who is now retired. Earl Hatten. He read the Christmas Story again for us at the employee party on Friday. Remember this was Bob Wingrove who was a great inventive person, has his own company. Dale Blosberg, who still is active with the company, the one person, I think, from the garage, who is still active with the company. This is Palmer Hermundslie, who died in 1970 as a diabetic. Neil Heraly, who’s still with the company, but is on medical leave right now. “Goldie” Benson is dead. I guess that’s all that any of you might know.

Unidentified Speaker: They look pretty young, Earl. Were they college graduates or college students?

Earl Bakken: Some of them were college graduates. I know Wingrove was, and this fellow back here I know was. His name doesn’t occur to me right now, but he worked a
lot with Bethesda Hospital when they did the first work with the Stokes-Adams patients.

**Kirk Jeffrey:** Norman Roth?

**Earl Bakken:** Norm Roth. Absolutely. Norm Roth.

**Unidentified Speaker:** How did you find all those people?

**Earl Bakken:** I don’t know. I was not much involved in finding them. I was always at the University, and most of the getting people to come work with us was Palmer’s work, and I can’t remember exactly how we got the people to come there in the first place. But they all were very good and worked out very well and helped us get through those early years.

I just want to show a series of instruments here. People think the only thing we did back then was get into the pacemaker. But we did create lots of instruments before that. It used to be at the University of Minnesota, as I mentioned, we would start working with various departments, and they would say, “We have this million-dollar idea. You’ll sell these like hotcakes.” We would build one or two units, sometimes seven or eight units, and that was the end of it. We would have spent a lot more money in designing those units than we ever recovered.

This was a single unit that we built for Mount Sinai Hospital research. This is our early electrophysiology unit with cardiosynch for synchronizing things with the heartbeat, various types of pacing modalities.

This is another one that we built, an integrator. We sold all the Sanborn equipment, and what they wanted to do was sometimes change, integrate some function from flow to total air passage or various physiologic phenomena that they wanted to get the integral of the phenomena they were measuring. Now, of course, we can do integrations, thousands of them, on a chip. But, back then, it took a lot of vacuum tubes, and, of course, all of my education was in vacuum tubes. This was all prior to the development of the transistor in 1955.

We did make a lot of vacuum-tube devices. This was a very effective integrator using polystyrene capacitors and all were keyed back to hold it steady. Back in those days, we put things in nice wooden cabinets. They sure had a lot more therapeutic effect than devices put in a tin cabinet or the way they mostly look today, they’re not going to help the patient’s psyche.

In the early days of Medtronic, this was the oscilloscope that we used. Probably most of you have never even seen a one-inch oscilloscope.
Unidentified Speaker: Is there a little screen under your thumb there?

Earl Bakken: There’s a little screen in there, a little one-inch screen. There’s no way of really calibrating it, so when we made our first pacemakers and wanted to get two milliseconds, we were probably not very close to two milliseconds, but it was enough to give us a glimpse. This was actually an oscilloscope my mother bought for me when I was in high school and [I used it] throughout college, and it was one we used to begin Medtronic.

Then we went to the five-inch Heath kit that you could buy for $39.75, something like that. It still wasn’t much more accurate, but it kept us puttering along. Now this oscilloscope we have are incredible. If they get a year or two old, then the engineer has to have a new one, isn’t that—more digital calculations. But we struggled through in those days with pretty simple equipment.

Here’s some cautery forceps that we developed to cauterize bleeders easily, just by squeezing the forceps. You could pick up a bleeder and then squeeze it. This work was first done at Northwestern Hospital, now Abbott Northwestern or the Allina group.

Unidentified Speaker: What about the regulatory influence, or lack thereof, in those days?

Earl Bakken: Oh, it was lack thereof. The first intrusion of the regulatory agency, the FDA [Food and Drug Administration], came in 1975. Prior to that, they had no control over devices. I remember going to a meeting in—I think it was in Bethesda—a couple of years before that, ‘73 or something, and heard a talk by a person from the FDA about the upcoming taking over of controlling devices. He was very explicit of what he was going to do to these terrible device companies and all the harm they were causing and all the problems he was going to create for them to get approval. It was just a terribly frightening lecture. That’s the first time I went out in the evening and got drunk. [Laughter] I was a teetotaler really up to that, and I started drinking Black Russians.

But it was pretty frightening, and, of course, it’s turned out to be much worse than we even anticipated. But, back in those days, it was wonderful. We had to depend on our engineering integrity. We had to depend on the doctors and their intellectual ability to say this is safer for the patient than not doing anything. There was a surgeon by the name of Dwight Harkin, who came up with the comment that, “The device is safe if it’s safer than the disease you’re treating. It is the best approach to treating the disease at that point in time.”

But that’s not the philosophy of the FDA. If they want to treat anybody, they want to be sure that they’ve got a device used only—it doesn’t save the person. It isn’t there to save the person. It will never hurt anybody. And, of course, there’s a zero trade-off to have
absolute safety in effectiveness. But I remember in our meeting, we got into some problem along the way. I think it was with the Zytron. We had a lot of failures because we began using “ready, fire, aim” and went through a process of making pacemakers when the electronics was in a sealed can, solder sealed, and we had it fail at a higher rate than was acceptable.

The FDA was going to bring criminal charges against us, so they started the trial, and the trial group met here in Minneapolis. Dwight Harkin spoke, and Art Bell from Houston spoke, and they are both so eloquent that the lawyers from the FDA folded up their case and left. They were powerless against the eloquence of these two surgeons.

And now, of course, we are moving more and more of our ventures in research in the things that I mentioned earlier, and we’re big enough to be able to do that, but it’s a shame that all of those jobs are moving out of Minnesota. We will continue to have a growing research effort here in the spectrum of the nonclinical areas.

**Unidentified Speaker:** Is the FDA getting somewhat easier to deal with as far as drafting permission to introduce—

**Second Unidentified Speaker:** The answer is no.

**Earl Bakken:** I think that’s a good answer. In some ways they’re trying to move a little quicker, and in some ways they are much more difficult, unreasonable. You never know what the rules of the game are. They are trying their best. They’re in a very difficult position as career people never wanting to make a mistake, not really understanding what the project is all about.

**Unidentified Speaker:** They’re bureaucrats.

**Earl Bakken:** Yes, and they’re caught between approving devices that—Congress is leaning on them, no matter what they do, they’re condemned as doing wrong.

**Unidentified Speaker:** What triggered the whole regulatory thing coming on medical devices? Was it the fact that there were people being sued? What stimulated that since it seemed to work so well for how many years, you know, since the war and—

**Earl Bakken:** I think it was just the recognition of here was a field to control. There was no great harm being done. I won’t say that our company didn’t push through devices, but you can’t stay in business if you are making unreliable devices. The market is going to control the quality. If you have a mission to release devices that are effective, there’s no better control than their own existence. It’s just like now there are all these herbs and other approaches to medicine that are extremely good. Millions of people are using them. There is no harm being done, but the FDA is saying that “We ought to control those
because of their dangers.” There’s no danger. But that doesn’t make any difference, and that’s not the point. It’s never been approved. In that case, there’s a lot of pressure from the drug companies because herbs cannot be sold [unclear].

Unidentified Speaker: For how long did you make your original instruments by the “ready, aim, fire” method before you—I imagine you got off the schematics or other design by which to create these barbarous instruments. I imagine before that you made the original pacemaker “ready, aim, fire.”

Earl Bakken: Well, as I mentioned, when we had the power blackout in 1957 and some of the children at the University of Minnesota were on AC-powered pacemakers—I’ll talk more about that in a minute—we came up with the need of a battery-operated pacemaker. That’s what we all wanted. And from the time we really talked about it till when we really began to use it on children was about four weeks. There was no resistance to using it, because, as Walt said, he wasn’t going to risk another day of losing a child to an AC power failure when there was a DC device available.

Now, when I say “ready, fire, aim,” I’m not ignoring the getting ready. There was a certain amount of getting ready, but what I do want to go into was all the analysis paralysis of studying what the market potential was, all the other sequelae, because, as a company, if we get caught in the moment of “ready, aim, aim, aim,” somebody else would have fired, and you’ve lost the market. I’m not advocating foolish things, but you can’t know all the answers because there is no way preliminary to going into some adventure to know what all the variables are. You’re never going to know until you try something and then adjust your aim later on that you see whether you’re missing the target.

With that first pacemaker we developed for Walt, it was not quite on because it didn’t hit the target precisely. It kept children alive. I have a model here, but the real one is in the other room. This is a model of the first one that I built in a Budd box. The circuit work was plagiarized from Popular Electronics magazine from that time because I didn’t know how to design a transistor circuit. But this was a two-transistor pulse generator that put clicks on a loudspeaker, and those clicks are just pulses of electricity coming off the loudspeaker, off the terminals. At the University, they would put one wire into the child’s heart while they were operating on the blue babies, and the other one would connect under the skin to close the circuit.

This did the job of pacing the child’s heart, keeping him alive until they started conducting on their own. But the children would start playing with the knobs, turning it on and off, and, of course, the nurses had to tape this all up when they used them. So we had to go to the redesign of the unit to put the pacemaker into a box where the little fingers couldn’t get in there and change the knob and with its on/off switch that was difficult to use.
This, then, was the ultimate design because the pacemakers of today are almost the same. We didn’t make any improvement after these. These handles we stole from the handles on electrocardiograph machines. This was a routing machine done with a piece of plastic. But these work well, but we couldn’t have foreseen all of the difficulties. They were affected by cautery. We didn’t know that ahead of time. We had to shield these internally so the cautery wouldn’t cause them to erode away. So I think that theme of “ready, fire, aim” is good as long as you’re ready to adjust your aim when you start making the devices or doing the procedure.

I am now involved with building this hospital in Hawaii, which is a new invention, but we’re doing it on a “ready, fire, aim” basis. We can’t know all the answers to each public that we have to deal with, and so we’re just doing it, and it’s going to work out.

Here’s another early instrument, the dye injector. I don’t think many people know that Medtronic was in the dye-injection business. We developed an electronic synchronizer to synchronize the heartbeat with anything you wanted to synchronize with, a camera, or whatever. So we developed this, and it was used at the University to prove some of the first displays of coronary arteries. What they would do is to stop the heart and that would trigger this injector, with the heart stopped. It would fill the coronary arteries, and then we would start, hopefully, restart the heart, because you couldn’t exactly get it timed to get a good display of the coronary arteries. With later devices, of course, we could, and today they, of course, don’t stop the heart to get a simple display of the coronary arteries. But we did quite a bit of work with this together with a company here that made most of the mechanical parts. It was Chris Possis’s. He just recently died.

This is an interesting one. This device we made for the farm campus, and it’s a semen impedance meter. This was sold to several cattle ranches, and it’s a device where you put some electrodes, platinum electrodes, down into a container of fresh semen from a bull, for cattle ranches. The sperm swim in groups, and the impedance would change as the sperm swam through the electrodes, and you would measure the number of openings and closings of the loop in a given period of time to get a calibration of how active the sperm was. Then the cattle ranchers could divide the sperm samples down, depending on the activity, and settle more cows. If it were slow sperm, they might have to use a larger sample to be sure they would get a potency.

We sold millions of these devices—well, not many, probably ten or so—to different ranches around the world, including Korea and King Ranch in Texas. Anybody know we made such a device? You remember that, Tom [Holloran]? It’s an interesting project. We usually did these projects as a service to people who were using the multi-channel Sanborn equipment. It was not that we were really thinking that this device was going to be a market, but we really didn’t know.
**Unidentified Speaker:** Is that a thermos bottle?

**Earl Bakken:** Yes, a Thermos bottle. It had a constant temperature so the temperature wasn’t one of the variables. Very simple. It’s a Heathkit that we modified with the right kind of bridge and amplifier and put some really costly [unclear] pots in there to get good toleration.

We made all sorts of monitoring devices. This was a telecore electrode. It would go down the esophagus and measure heart sounds and core temperature and something else, I can’t remember. We measured about three things from the core of people that were going through surgery.

We made lots of these oscilloscopes. We actually made some dual-channel oscilloscopes for monitoring in the early surgical, or particularly we sold a lot of the Sanborn equipment for laboratories measuring cardiac output and the green-dye injection for cardiac operations. The first heart cath lab we set up around the Twin Cities. The oscilloscopes weren’t really available for doing this kind of work, so we began to manufacture some of them. We actually have some of these left, don’t we, of many of these.

**Unidentified Speaker:** What vintage year are we talking about in these instruments?

**Earl Bakken:** Well, this is after we were into pacing. This is really not before pacing, but we got into defibrillators. These were just the defibrillators that used a transformer that would give you 700 volts of AC output in the paddles. I think we have some beautifully designed cabinets. They’re a little smaller at the bottom and blue-colored, metallic blue, nice-looking stuff. I don’t think they’re quite as fancy now.

This was a picture in the production line. I don’t even know what we were producing there, but this was when Palmer was entertaining the governor at the time, Elmer Anderson, on a tour through Medtronic. So we were getting a little bit of recognition, but he was a particularly good governor.

This is where we were when Walt [Lillehei] and his people, were doing this first open-heart surgery on the blue babies and came up with heart block. We inadvertently produced a heart block by sewing a patch over the interventricular septal defect on the children.

These were the pacemakers that were available at the time. They’re AC-operated. They had to be plugged into the AC lines. They were vacuum tubes, of course, and they were designed to have a 150-volt output out of the output jack and a pulse, two-millisecond pulse, because they were designed for external application to the heart at standstill and made for adults.
This 150-volt output from the pacemaker was too high to really use on the children because these little children had come through surgery, and it hit them with a 150-volt pulse, even though it would stimulate the heart, they would just bounce and could not stand the trauma of the device. So we developed a method of reducing the 150 volts.

We used to make a lot of 10/1 dividers, so that you could only turn them up to 15 volts. And then Walt and his residents began putting wires into the hearts of the children at the time the chest was open and bringing wire out through the chest and connecting it to this device directly. There was no danger of them fibrillating with it because you couldn’t turn the output up above the 15 volts, but with 150 volts, you could easily fibrillate the child if someone turned it up too high.

This began to work because, within a few days to a week, the children would recover. They’d start conducting on their own again, and you could wean them from the pacemaker. But in October of 1957, there was a power failure which we faced. Northern States Power remembers it as “Black Thursday.” Something went wrong with the safety-control systems at all the power plants in the Minneapolis area. One plant went down, and that somehow sent false signals on the circuit, and every power plant in the Twin Cities went down. The safety links responded to a false alarm somehow. But when the generators go down, it takes several hours to get them up again and on line. So the failure of the AC was continued for several hours.

At the University of Minnesota, they, of course, had emergency power in the surgery and recovery rooms, but they didn’t have emergency power in all of the patient rooms. So some of the patients really got into trouble. I’m not sure I remember all the details, Walt, but I know following that, you came to me looking for some way to have a battery backup to keep these things going during a power failure. I said, “Sure, we will put an automobile battery down here in the bottom.” They were 6-volt batteries back then. That’s how far back it was. “And then we’ll put an invertor to change that 6 volts to 115 volts and run the pacemaker, and then we’ll put a battery charger down there to keep the battery charged. As long as there’s AC, the thing will keep running really on a battery charger.”

But if there was a power failure, the battery would run it for several hours so you could get the child to an area where there was emergency power. And this gave us the ability to move the children, also, without running extension cords down the hall.

But I went back to the garage to think about it and put that together, because it was easy to do. It’s just all our components are available. But it dawned on me that why go through a whole cartful of apparatus to end up with a little 15-volt pulse, and just a very few milliamps is all you needed. And so I said there must be some way of putting this in a smaller case. So this was ’57, and it was just about when transistors had become
available, particularly for home projects. They weren’t really used in transistor radios until ‘55, or some of the first transistor radios in ‘56, so these transistor things were pretty new.

This shows you the Electrodyne, a bigger picture of the Electrodyne pacemaker. This is the first pacemaker. I don’t have a circuit diagram, but if anybody wants a copy of that plagiarized article from Popular Electronics from 1957, in the Pavek Radio Museum I have a copy, not a copy, but a real 1957 Popular Electronics showing the circuit that I plagiarized. I had to change some of the time constants, but you know metronomes are the same rate as heart rate. I didn’t have to change that. But we had to adjust the pulse just a little bit, so it was simple, even I could make it work as a nice pulse generator. And so that was the first pacemaker, and Walt and others began to use it at the University of Minnesota.

**Walt Lillehei:** That was the dog model you delivered, but the next day we used it on a patient.

**Earl Bakken:** Yes. It was quite startling to me. I made it as a prototype, and we tried it on a dog, and I went back to the garage to make something to use on children. The next day I came back, and that unit was attached to a child. That’s when Walt said he wasn’t going to take the chance again on losing a child as long as that was available, so to me it was a thrill. Here is something we had made supporting a child’s life. On the other hand, I worried was this quality enough to be used on a child, because we hadn’t really anticipated that use. But on the original pacemaker, if you connect a battery to it, it still is just as reliable as it was back then. But then they made a couple of these in black. I think you still have one, Walt, in black.

**Walt Lillehei:** I think I have the first human model. Too bad I didn’t bring it, but it has hand-made dials. I suppose you’re going to show the conventional oblong shape in your next slide.

**Earl Bakken:** I don’t have any more slides with me. We made one in black, but black didn’t seem like an appropriate color in the hospitals. We found when we made it in white, we sold more, but they would get lost in the laundry where they would attach it to the sheets.

Walt began to write papers and tell residents about using this device, and, of course, other surgeons never had heart block, but they began to order these things. So that was the beginning of the electronic manufacturing businesses. We never had any idea that it was going to be a market like it is. It’s gone way beyond anybody’s expectation.

Medtronic had a market research study done in 1962 by A.D. Little Company as to what the all-time worldwide market would be for pacemakers, and they came back with a
study that 10,000 units were all that would ever be possibly used, not for a year, but for all time, because people just never saw heart block. It was so rare. But it just gives you the example of so many things, until there is a device to treat it, the problem isn’t always recognized as a problem. Now, of course, the total market is something like 300,000 units per year.

**Walt Lillehei:** What’s the total market? I didn’t catch the figure.

**Earl Bakken:** I think it’s around 300,000 now. Is that close to what we and the other companies are doing?

**Kirk Jeffrey:** Yes, it seems to me that as long as they were external, probably the hospitals and the people who did market research expected the device would be used for a few weeks by a child and then passed on to another patient, and so any one unit might be used over in patients.

**Earl Bakken:** This was done when we first went into the implantables. And what you’re saying is very true. As long as this was only available as an external, and in 1958 they started using it for permanent use for Stokes-Adams patients, but physicians from the small towns didn’t want to have it put in or connected to one of their people, because they were afraid of it. But as soon as they became implantable, and local physicians could send their patient in to have it implanted, then the market increased quite a bit. But this was after they were making the implantables.

It was actually the Mallory Battery Company, and we were using their batteries in the implant. They offered to buy us. We had originally issued our debentures at a dollar and a half a share, and they were willing to double that to pay three dollars a share and buy our company. So we had this market research study done, and then they backed out of it. Of course, each of those dollars back then would have been, what, $8,000 or so today. So it was very fortunate that they backed out of the deal, because we were ready to sell because we didn’t know what a real potential there was for these things.

**Unidentified Speaker:** When you started making the implantable models, to what extent was sterilization a problem that you had to deal with and the sensitivity of the components to being sterilized? I presume these were sterilized before they were implanted.

**Earl Bakken:** Yes, they were generally sterilized before use. The original sterilization procedure was Zephriran, a cold sterilization.

**Unidentified Speaker:** Just of the external?

**Earl Bakken:** On the outside. We never had any real great problems, really. We started
to make these in the garage just in an open room, and the silicone is very compatible
with the body unless you get foreign material in it. Some of these would get scraps of wood or
vegetable or something. We would get these brown spots on the surface. Ethylene oxide
really wasn’t used much back in those days. It was steam sterilization or cold
sterilization, and you can’t subject these to the temperature of steam. They just won’t
tolerate it. But we never really had any great problem with sterilization, really. We
soaked them in Zephiran.

**Walt Lillehei:** One of the problems with the early pacemakers, the early implanted ones,
as you know was that the batteries all emitted hydrogen when they discharged, and so all
the canisters had to have a vent to let the hydrogen out or the canister would have
exploded. But that vent became quite easily a two-way vent and let saline into the
electrical mechanism.

**Earl Bakken:** Yes. You might have heard me mention a case in this era we couldn’t
enclose the can because the cells, as they processed, gave off hydrogen gas, and we
[unclear] all the gas that stayed. So we designed the circuits and buried them in
Scotchcast 5, which happens to be a very good insulating material. And even though
water vapor will eventually go through the wood, we designed the circuits with the
values of the resistors and the relationship of the resistors so that if there wouldn’t be
conducting paths, we made this to work in 100 percent humidity. Then we got to the cans
with the hermetic seal, and of course the units became much more, incredibly more
reliable where you could actually use the batteries that don’t put out a gas, and that is
what we’re doing now, seal [unclear].

But there was a lot of learning curve back then in those days, and there weren’t a lot of
rules. Medtronic has often been the pioneer in many ways. And that is sometimes even a
struggle, but we still tend to want to do things and then aim. We did our aim later on. If
we want to be the leader, we need to do things special, doing special things to help
people live better, fuller lives.

**Unidentified Speaker:** What percentage of Medtronic’s business today is pacemakers?

**Earl Bakken:** I don’t know the exact figure, but it’s probably about 60 percent.

**Unidentified Speaker:** It’s like about 45 percent.

**Earl Bakken:** Is it down to 45 percent? In the last few years, we have diversified so
much that we are offering a much fuller spectrum. Defibrillators, of course, are making a
big addition to other areas. If you include our defibrillators and pacemakers, I suppose
it’s still 60 or 70 percent, but we have valves and angioplasty and drug pumps and a
whole spectrum of implantable or invasive equipment, and that’s our focus.
Bill Hoffman: This era of electronics from vacuum tubes to transistors, what do you remember about this? Personally did you have any anxieties yourself about moving from something you were quite comfortable with to this new technology?

Earl Bakken: Well, I didn’t have to be anxious about it, because when the pacemaker market started growing in 1960, I went from being an engineer and running the company and then hired all these other engineers who could be under stress [unclear]. I never had to really make that transition from vacuum tubes to the transistors, because we have now something like 3,000 technical people in the company worldwide, [unclear] total aspects of computers. All of our devices are computers. The implanted device and the control systems are all computerized. They are becoming ever more so. As a result, they become simpler and simpler, but inside more complex than ever, with thousands of semiconductors, [unclear] just as we have now [unclear] and all the things you ask me to do with that, numerous radio-controlled combinations [unclear].

Richard Gillen: Was there a time in the early days when all of a sudden you clapped your hands together and said, “My God, this is going to go. This is going to be a [unclear]”?

Earl Bakken: I’m not even sure of it today. [Laughter] I can’t say there was any specific time that we really recognized that we were over the hump. It always seems like there’s a new problem. Obviously, I think we are in pretty good shape today. We are in such wonderful shape today that it’s wonderful for me to be living in Hawaii and know that everything is going well back here. I don’t have to be concerned about decisions that are being made. I can just work there in the hospital. I’m turning northwest Hawaii into a world health center. I’ve got some new pens to pass out, but beyond the hospital I’m doing, when I finish with that hospital, I’m going to be devoting more time to the Five Mountain Medical Community. This is the pin for the Five Mountain Medical Community and the Five Mountain Medical Center.

But the company is under such good management, here and around the world that I’m free to do my thing there, knowing that the right decisions are being made here with our management structure and the people all the way through the company. So it’s really satisfying. I’m not sure that there are many founders of companies that can have such an ideal situation. So often founders have to go back into the company to try to salvage something because the direction was changed. In our case, the direction hasn’t changed. I think most of you know I do new employee meetings for all of our new employees around the world, and I spend an hour and a half going over the mission of the company, which we wrote in 1960, when I changed from being an engineer to a manager.

I still go to all these new employee meetings. I’ve done two in the two weeks I’ve been here so far. I had one today with seventy-five people. I will be doing one in May in Phoenix and Denver, for the new people. But our company now is growing so fast, and
my ability to get around anymore is limited because all my work is concentrated in Hawaii. Bill George, our present CEO and president, is going to start helping doing new employee meetings for me. He’s going to do essentially the same thing as I have, a little bit of history, but a lot of time with the six mission statements. I think that’s so wonderful and so credible for employees today to know that even though I’m not there on a day-to-day basis, this thing’s still the guide that Bill George and the other top officers use. So he’s going to be able to get to some of the new companies in Europe and South Africa and so forth before I can get there. I’ll get there when I can, but I don’t have to worry about getting there right at the beginning. So I’m pretty excited about that prospect.

By the way, this hospital that I’m working on in Hawaii is now 90 percent done and open for patients in April, and it’s going to be very creative. It’s going to be a very different kind of hospital. I don’t even know if we could call it a hospital. It’s a healing center in and of itself, the building, and I really can’t convey to you how different it is. We’ve always advertised it as “Not just another hospital” is the slogan we use. But I invite you to stop by to visit us there on the Big Island. That’s not the island where Honolulu is; it’s the Big Island. It’s very lightly populated, and I invite you to visit us and tour the hospital and really know why it’s different and why it, again, may be a model for the nation, like the first pacemakers were a model for the world. So when you’re on the Big Island, please call me up, and I’m in the telephone book. The hospital is also in the telephone book, so just give us a call and we’ll arrange to take you through there.

Any other questions or comments?

**David Rhees:** The recent Twin Cities industry cluster study discussed how important venture capital is, especially for the small start-ups when they’re trying to scale up production and so forth. Where did the financing come from? Who was willing to spend money on your company?

**Earl Bakken:** Well, in the very early days of Medtronic, we sold some debentures, and a lot of them we sold to friends. We sold $10,000 worth to a jeweler over on Central Avenue.

**Unidentified Speaker:** Which one?

**Earl Bakken:** A few years later he became a millionaire and quit the jewelry business and became an investor for [unclear]. Our first chief financial officer we gave several stock options to, and at a certain point in life—I think he was about forty-five or something like that—he said, “I’m quitting. I’m going to play golf in Colorado for the rest of my life.” He had all these stock options, so he had lots of money. Instead of keeping him with us, it pushed him away to enjoy life. So that didn’t work. We had one family friend that had $1,000 that Palmer was trying to get them to invest in the company. The husband wanted to invest, but the wife said, “No, we need a new used
car.” And so a few years later he could point to his $300,000 used car. [Laughter]

We had lots of stories in those early days. Then we went to several venture capitalists. In 1960, when we made the first implantable pacemakers, we were essentially bankrupt. It got to the point where we were spending more money than we had income. I, not being an accountant, couldn’t quite understand that, but that made a difference. But we added some people to our board, a small-business investment company by the name of CIE. They’d put a couple hundred thousand dollars into our company, if they could have two people on our board. And we found a banker from across the street with a bank that we were dealing with. It was going to foreclose on that loan, and we found a banker, a foolish banker, who would take over the other bank’s loan and put some more money into us, if he could also come on the board. So we acquiesced to that. I didn’t realize—the money, of course, was absolutely essential to keep us going to meet our payroll, but it was the direction and help of these people coming on the board that really caused us to write the mission statement.

One of them was from the man who built the Minnesota Valley Can Company into the Green Giant Company. He came up with that name because the Minnesota Valley Canning Company had developed this large green pea, and back then people wanted small green peas, not large green peas. But this green pea was delicious, it was sweet, it was wonderful. So he came up with the Green Giant slogan, and then they could sell their giant green peas. Jolly Green Giant. But he was exceptionally good on our board. He’s now dead. The banker is now dead, but the third person is still on our board, a man by the name of Gerry [Gerald] Simonson, very valuable on our board of directors.

And then in the subsequent years, we had two or three stock offerings. And now, of course, our problem is too much cash, so we have to find an active mission for other things that were meaningful, so we don’t allow our cash to build up too high, to high levels, and have someone buy us with our own cash.

Unidentified Speaker: When was your first public offering?

Earl Bakken: The debenture issuing was 1957 or 1958. And then there were several in the early sixties. I don’t remember the exact dates.

Any other questions?

Unidentified Speaker: I wonder how our time is, David.

David Rhees: Well, I think it’s about time to wrap things up and move on to refreshments. My original hope was that we’d have time for everyone to introduce themselves, and we can help figure out who each other are, but there were so many folks here. We had such a wonderful turnout, I’m afraid we’d be here the rest of the evening,
so I’ll invite you to introduce yourselves to each other during refreshments in the sun room.

And I hope you’ll join me in thanking Earl Bakken for just a stunning talk.

**Earl Bakken**: Thank you. I just wanted to add that if you haven’t gotten into the campaign for the Biomedical Engineering Center for the University of Minnesota, Walt and I are co-honorary chairs for the founding of the Biomedical Engineering Center. We ask you to give that center some help in raising funds to endow our center, and the man right here can help take care of it if you want to contribute.

Thank you for coming and *Mahalo*.