Project Bionics Pioneer Interview
William S. Pierce, MD
Interviewed by Steven Phillips, MD
June 4, 2013

Steve Phillips: Doctor Pierce, I want to truly thank you for taking time out of your schedule and doing this interview for Project Bionics. It's a beautiful day in June and we're here at the National Institutes of Health and again, it's just delightful to see you and renew our friendship. As you know, this Project Bionics has been going on for a number of years and the purpose of the project is to interview the innovators and pioneers in artificial organs history. And you certainly are one of the major innovators and pioneers in this field.

William Pierce: Well, thank you very much Steve, you're very kind.

SP: You're welcome. We'd like to spend a little time just going over the history of what you've done and why you have done it and the trials and tribulations that you've gone through and how you contributed to the whole field. So I might start by asking you why did you decide to do what you have done? Was it when you were six years old and you--

WP: Well, I was always interested in engineering type things. I went to Lehigh University and studied chemical engineering, and toward the end of my time there, I got a little disenchanted with some of the things that I saw and decided that maybe I would like to go to medical school. And I'd always loved to do things with my hands so as soon as I hit medical school, surgery was on the forefront. And heart surgery was still at its infancy in the 60s and I saw a number of people that had what seemed to be successful open heart surgery but couldn't be weaned from the heart lung machine and I likened it to having a broken a leg and getting off the operating table and walking, and that didn't seem like a good idea at the time. And it seemed to me that it ought to be possible to support the circulation for a period of time, and I thought that these damaged hearts would heal. And I originally teamed up with several engineers at the University of Pennsylvania. We worked on a mechanical heart assist device. I then spent two wonderful years at the National Institutes of Health, in the clinic of surgery with Dr. Glenn Morrow and worked on the same sort of thing, and so by the time 1970 arrived, Hershey was a College of Medicine at Penn State was a brand new place and so it was kind of my third shot. And so with the help of the College of Engineering at Penn State, we developed a team of people with the primary goal of developing a mechanical heart assist device that could be used for a period we thought of about a week after open heart surgery, and it would allow a patient who had had seemingly successful surgery to be weaned from the heart lung machine. They'd stay on the mechanical device for a period of a week and then we felt the device could be taken off.
SP: You recognized very early as a young investigator that a patient could be supported by a heart lung machine. And yet when you tried to wean from the heart lung machine, the heart sometimes failed. So you were interested in developing a device to support them until the heart recovered. What was the model that you were using? You brought some of your devices with you, but could you describe a little bit?

WP: Yes, we worked on calves that were just weaned so the animals weighed about 180 pounds and since our medical center in Hershey was built on a cornfield, we had a ready supply of calves; all the females went to the milking herd for in order to make Hershey Bars and the males were sold as veal calves. So we had a source of, a ready source of animals and they turned out to be very docile and they were wonderful animals. They tolerated being on the heart lung machine when that was needed. They tolerated that very well. So, our plan was that we would set up a combined effort, so we had physicians, we had residents, the medical students that would be involved. We had the wonderful College of Engineering at Penn State, so we had a staff and graduate students. So we thought that we had set up a pretty functional, multi-disciplinary team back in the early 70's. We made several different designs of heart assist pumps. Our plan was to use a device that had a very smooth surface. Mr. John Boretos and I had worked, while I was here in Bethesda at the NIH, we had taken the material that we all know as Lycra spandex and dissolved that material and made what we thought was an outstanding material for use in mechanical heart devices. It was sold for a while under the name Biomer and most people now recognize it as segmented polyurethane. So we wanted to make devices that had a highly smooth surface, seam free, segmented polyurethane and they would use—- it would be pulsatile and the valving system would be related somehow to successfully used mechanical heart valves. So the device that we came up with after some trial and error is what we call a pneumatic ventricular assist device, and some of the features of this are a highly smooth, seam free, blood contacting sack. [Displays this device here.] It uses Bjork-Shiley tilting-disk valves. It's the type that has a monostrut valve. These have been used widely in Europe and have never failed in clinical application. And then the device is pneumatically powered so there's an inner tube here and it could be used for—- it would sit outside of the patient and blood would be taken from the ventricular apex and pumped back into the aorta. So we used the device in a series of about ten or twelve calves back in the early 70s and the animals were pumped for a period of a month or two which we felt was three or four times longer than it would be used in clinical application. And so in 1975 we sought approval of our Clinical Investigations Committee at the medical center. At that time the FDA [U.S. Food and Drug Administration] was not involved with these devices and our Clinical Investigations Committee approved it for use in a small series of patients and then we were to report back to the Committee as to how we did. The first two patients in whom the device was used had critical aortic stenosis, and this was back before we were using cardioplegia and these hearts developed the feared complication in operating on patients with aortic stenosis and very thick walled ventricles, they developed what was euphemistically called a "stone heart." The ventricular cannula was put in and the device was hooked up. Everything seemed fine and we couldn't pump, and the problem—we subsequently took one of the patients and put barium into the left ventricle and saw that the ventricular cavity was pretty much obliterated and that was the problem. The third patient--it was a lady that was in her mid-forties. She had a mitral valve replacement and a
single coronary graft which would have been “duck soup” now. But back then combined procedures did have a risk associated with them, and the device was put in. A whole team of engineers were there helping in the operating room. We had sort of checked ourselves out in the animal facility and put the pump in, turned it on. The patient was able to be weaned from the machine and the patient was taken into the Intensive Care Unit. She never woke up. At six o’clock at night, no, she wasn’t awake. At eight o’clock she wasn’t awake. I talked to my boss and he said “Well you better get a neurosurgical consult.” So we asked the neurosurgeons to come look at the patient and they examined her and they said there’s no hope. You need to turn the machine off. She had a good blood pressure, she was making urine and everything else seemed fine. So we said well, we set up a schedule to sit and watch the patient overnight and one of the engineers had the 4:00 AM to 8:00 AM shift, and I walked in at eight o’clock in the morning and the engineer said to me, “Would you step out in the hall with me for a minute?” And I said yes. I walked out in the hall. He said, “That lady has been watching me since four o’clock. Every time I moved she turns her head and she’s watching me.” Well, to make a long story short, she woke up and within a day or two she was able to be weaned off the respirator and we waited about a week. We were able to shut the pump off and remove it and she was our first survivor and she lived for a number of years after that time.

SP: Well, I remember hearing your presentations and the excitement associated with the successes. And I don’t know what you would call it; serendipity, luck [laughs], when one team of physicians say there’s no hope--

WP: Right.

SP: And I think it’s a tribute to you and your team to persevere when you recognized the fact that the patient is stable and making urine and there’s really no reason why she shouldn’t wake up [inaudible].

WP: We had no hope, no thought that this device would have any role in cardiac transplantation. In fact, a friend of mine when I was at the NIH the day the—1967, I believe—when Dr. Barnard did his first heart transplant, a friend came up to me and said, “Well, it would have been a nice research project--mechanical heart and assist pump. But it looks like none of that’s going to be needed.” Well, it turned out then in the early 80s, Don Hill was the first person that used this pump as a bridge for cardiac transplantation and very shortly after that then, the use expanded a great deal and people found out that it was very versatile. It could be used for right ventricular support, left ventricular support, and in almost half of the instances for biventricular support. And it could be used for weaning, but as cardiac surgery became so much safer, it’s rarely used for that indication now. But the major use has certainly been as a bridge for cardiac transplantation and there are now small enough pneumatic drive units that the patients-- first they went to, they were in Intensive Care, then Intermediate Care, and now the patients are able to even go home and wait for the phone call that a heart transplant is available.
SP: And I know your reason for building the devices was as a bridge to survival from heart surgery.

WP: Right, exactly.

SP: And did you ever conceive that--

WP: No, no.

SP: That it would be used as a bridge for transplant?

WP: No, we didn't.

SP: But coming from Iowa, the old saying is build it and they will come [laughs]. Is that right?

WP: A perfect example. Yes.

SP: Let's shift gears just a bit. Would you talk about some of the difficulties that you had, and some of your colleagues that perhaps were negative related to the research and the use of the resources of the University and how you overcame that?

WP: Yes. Well, the first difficulty we had was getting the--we thought we had an excellent biomaterial and we originally obtained a thread--a Lycra thread from the DuPont Company and then we were in touch with the people in the Lycra Division and got that we said couldn't we get the material before it came through what they call a spinnerette to make thread? Well, yes, we could, so we got a gallon or so of that material and it turned out to have a wonderful flex life. It had no migratable plasticizers in it and it was easy to fabricate in the laboratory and so we would have actual--we wanted more material and that got up to the hierarchy at the DuPont Company and they said no, that this was, had been developed in the Fiber Division and if we weren't making fibers, they were not interested in it. And we were--a man by the name of Dr. Lester Goodman was the head of the Engineering Program at the NIH at that time. That was between '65 and '67 and he used some of the weight of his office and of the federal government and the DuPont Company finally worked out an arrangement with Johnson and Johnson. So the material was made available and it had the trade name of Biomer; B-i-o-m-e-r. So that was one of the things. We have emphasized from the beginning, a close cooperation between people in, first of all in medicine so we would have Surgery, Cardiology, Hematology. We wanted people who were material scientists to be involved with us. People that worked on the interface between materials and blood-contacting surfaces that that would be very helpful. And we were very fortunate to have--our first Engineering Director was Dr. John Brighton, who subsequently became the Provost of Penn State University and is a well-known person. Dr. Gus Rosenberg has worked as an engineering colleague since the early 70s and he's had a team of people. We think if it's a hematologist working with us, they need to publish their work in the hematology literature and move up the ranks in that field. We have Veterinary Medicine specialists at Hershey and the work with the calves;
the best ways to use the heart lung machine, how the lung care, pulmonary care should be taken care of. That all ought to go in the veterinary literature and that way everyone moves up the scale instead of having the physician sit up top; and they may provide guidance. But there ought to be mechanisms whereby the people in these other specialties can move up in the ranks in their field.

SP: Well, and obviously you developed a program that had continuity because people change, residents and researchers come and go--

WP: That’s right.

SP: And I think for someone who is listening to this interview, would you perhaps elaborate a little bit more on the importance of continuity, and even perhaps describe the concept that you pretty much stayed focused on one type of device. Some of the centers move all over, and there may be advantages to that related to diversity and understanding which device may be better than another. But staying focused on one concept I think allows the continuity and the development of the whole field. But perhaps you might comment on that.

WP: Well, a lot of the first area relates to continuity. There have perhaps been fifty Masters degrees that have been awarded over the years at Penn State on different aspects of this project. But there’s always a faculty member that’s in charge of them. And they have changed but they often have colleagues, so when one person leaves, someone else moves in and takes that spot. There are probably ten Ph.D.’s that have been awarded on different aspects of the program, and it turns out to be a project that people really get excited about. The graduate students hear about some of the opportunities and they just love working on different aspects of the project. Our pneumatic device-- we recognize that it certainly has its limitations so we have; but we’ve been very much wed to the concept of pulsatile support and we, even in the early 80s, began to transition our research work into electrically powered devices that would be able to be used for permanent circulatory support. Our feeling is that we know right now there are about two thousand patients a year that have heart transplantation. The need has been estimated by blue ribbon committees numerous times and there is at least a need of ten thousand hearts per year. And so what we’ve done is taken the basic concept of the polyurethane, seam-free polyurethane sack, commercially available cardiac valves and a pulsation that looks very much the same as the physiologic pulsation. And we have worked on, first of all, a left ventricular assist pump that was completely implanted and is powered externally but with no tubes or wires going across the chest wall. We’ve also focused on a completely implanted electric artificial heart which is sort of our ultimate goal in this work. And we believe at the present time that it is entirely possible to remove the human heart and replace it with an electrically powered artificial heart with no tubes or wires crossing the chest wall. We’ve done it in the calf model. The problem with the calves is that they have ravenous appetites and they grow very quickly, so after a year with the mechanical artificial heart, their venous blood looks like coal. It’s black and they have outgrown the heart and we’re not about to make larger hearts. We’re trying to make smaller ones that can be used in the human.
So Steve, this is the electric artificial heart [displays model] here that we have worked on and it has very similar features to the device that is often referred to as the LionHeart. But the LionHeart is a left ventricular assist pump that was developed for permanent implantation and the LionHeart has a single pumping ventricle, the same motor and internal mechanism. But it doesn’t have the second pump on it. The business end of the device is what’s called a roller screw which is a device that’s widely used in the machine tool industry. It has virtually no backlash and in this duty cycle on a blood pump, this easily will run for five years and the way it’s set up here, the electric motor-- it’s a brushless DC electric motor. Sits alongside or around the roller screw. It goes four revolutions in one direction and then counter rotates. So first it pumps the left ventricle and then it comes back and pumps the right ventricle. Interesting physiology because here we have hopefully in our own hearts, both ventricles are pumping at the same time. But that turns out to be just a need of the designer of the human heart. When engineers get to design a heart it can pump alternately. There doesn’t seem to be any problem with that and in fact in the Jarvik pneumatic heart, the two ventricles pump completely independent of one another. So you don’t need to have that synchrony. And the device has a monostrut Bjork-Schiley inlet and outlet valves, so an atrial cuff would go on here and a graft going to either the aorta on one side and the pulmonary artery on the other side. The energy is transferred-- this coil sits under the skin and another coil sits on top of it. Energy transmission through the chest wall was really developed by Dr. John Schuder in the late 50s and early 60s and it’s been improved a lot since that time. So it’s readily possible and it’s been demonstrated many times in humans that you can transmit as much as fifteen or twenty watts through the intact skin without any skin damage. This container holds the-- this was made, oh, just before the lithium batteries came in so this has NiCad batteries. So this is enough to run the pump for thirty to forty-five minutes while the patient takes a shower so they don’t have to have the external coil on at that time. When they then finish the shower and put the coil back on, it recharges the-- as I said this is NiCad. It wouldn’t do the same thing with lithium but the lithium is 30 percent smaller. A very tricky thing here, and probably the most development that we have come up with is the ability to control the output of the two ventricles and it’s done by controlling the speed with which these pusher plates move back and forth. So the big problem is that the right ventricle tends to pump more than the left. So what we do, we run the pusher plate to the left and then if we run it back very quickly, it prevents that right ventricle from filling all the way so you’re able to balance the right and left outputs with that technique. It does not require any use of a left atrial monitoring catheter or a blood pressure monitoring catheter. The left atrial pressure is determined by the fill time of the left ventricle, so if the left atrial pressure is high, the ventricle fills quickly and that figure is easily sensed electronically. The problem that one comes up with is that this is a closed space and to achieve control you either have to have an air tube that goes out through the chest wall or as we often call a pediatric hot water bottle which is sort of what it looks like and when the device is running and it’s under control, just a small mount of air comes into this and that allows control to be achieved. If this is not closed off, then the control system will not function properly. This is placed in between the lung and the chest wall and over a period of three weeks to a month, gases can leak through the polyurethane membrane. So we have a little chemotherapy port that sits under the skin and this can be accessed, the pressure
measured and additional gas put in. It's sulfur hexafluoride; it's a very large molecule and it doesn't dissolve very readily so that's the gas that's used in this device and it's also a gas that's used in other medical applications.

SP: The concept of using a single pump to pump both ventricles is certainly innovative. The pusher plate as you describe it--how did you come with that? Who came up with that?

WP: Well, that was one of the key features of the device, and we developed a control system for our pneumatic artificial heart. We did make a device that looks very much the same as the Jarvik heart but we developed an automatic control system for that. An engineer whose name is Don Landis, who has passed away now, spent day after day with a beautiful mock loop watching every, understanding every little pressure wave and came up with the control system for the pneumatic device and many of the elements of that were able to be applied to this system. And the idea of moving that plate back to control right pump filling has been one of the crucial elements of the control system.

SP: As far as the power source is concerned, now many years ago we were allowed to use nuclear. We had nuclear pacemakers. Jack Norman and others did incredible research and I don't know if you have any specific comments on the ability to use a nuclear source or how that would affect the--

WP: You know we certainly have been interested in that. A lot of money was invested in developing these strong, excuse me, the small Stirling Cycle engines but it's very easy with modern electronics to put this, this would be a secondary coil that sits over top of the skin. It's been used in patients many, many times now and I think that with the-- we happen to live five miles from the TMI [Three Mile Island nuclear reactor] accident and what's happened there and what's happened in Chernobyl and now in Japan. And I think that this is in my view, a here and now device. The nuclear power source is definitely something that we have to talk about in the distant future.

SP: Well, I think the lesson is that you innovate. You cannot use one source for one reason or another and you come up with another solution.

WP: Yes.

SP: And I think that's the beauty of you and your team, where you can think out of the box.

WP: And some things--for instance, this is quite heavy and it's larger than we would like but if you think about the original implanted defibrillators, it's not far in size from that and already over the past decade we can reduce this by, make it 30 percent smaller with the use of lithium cells. And the lithium cells are relatively new things. They're going to be more improvements. Every time they occur the advance in biomaterials to have the biomaterial, it was made because of the garment industry where people were talking about tons of material. But we want to be able to latch on to those advances; in the same
way the lithium battery was not developed certainly for use in mechanical, implantable, mechanical devices but that was latched on to very, very quickly.

SP: But the ability to recognize technology in other areas has been critical for all of us.

WP: That's right.

SP: And technology transfer and working with other disciplines has really made a difference.

WP: Yes.

SP: Would you comment on the regulatory aspects of your career and what has happened, and whether it's been helpful or hindering you or a combination of the two?

WP: Yeah, I would say that I have mixed feelings. We certainly were helped in the early 70s by not having to have the FDA involved. We had a knowledgeable group of both physicians and lay people at the medical center. We presented our animal experiments and they thought that it looked like the device would be safe and effective as much as one could tell from the animal work that we had done, and they gave us permission to go ahead and use the device. There have obviously been some terrible things that have happened. The so-called Gott-Dagget valve--when that was used, those valves came apart in patients because there were very minor changes that took place between the valves that had been used experimentally and the ones that were being sold commercially. There were examples with pacemaker leads and other heart valves, certainly. So it's a mixed bag, but it's definitely become a lot more difficult for the innovator to carry these devices into clinical application at the present time.

SP: Yeah, it's interesting because I guess my comment-- a drug, a chemical moiety starts out as an aspirin and ends up as an aspirin. If you change anything in it, it's no longer an aspirin. And yet devices need incremental changes as they develop.

WP: Yes.

SP: And it's still not recognized by the regulatory agencies that this is something that they have to factor that in.

WP: We've heard the quote that “If it's a minor change, don't make it.” If it's a major change, then you have to repeat the animal work and the animal work has become increasingly more expensive. We have the vision of the calf--or we now operate on some baby lambs--of them sitting in the back of a limousine with their legs crossed and a bottle in their hand and the chauffeur driving into the medical center in an air conditioned vehicle. [laughs].
William S. Pierce interview, June 4, 2013

SP: Well that was the next area I was going to discuss with you since you brought it up. How were you able to pay for all of this?

WP: Well, I would say 75 percent of it was through NIH grants or NIH contracts and we have been very diligent and we still; our group continues to have R01’s and all of the other types of support that we work on. There has been a sizeable project that was called the Artificial Heart Program run through the NIH. We were right at the cusp of developing an electric heart and all of a sudden the [William] DeVries implant of the heart in Barney Clark took place in Utah. And right after that, the government representatives at the NIH saw that these, what seemed like a very crude device being used in patients, and they thought there must be something better than that and we were the benefactors as were three or four other groups of significant NIH money for the development of these devices. We continue to apply for foundation support and there are the benevolent patients and people that have an interest in this work that make contributions. It makes a huge difference. A lot of our focus now is on a little pediatric heart assist pump, and when you start talking about babies and infants having heart transplants and needing support devices, people do tend to open their wallet, and it’s been a little easier to get money for that project than for some of the adult work. But it takes a lot of investigator time doing the grants, being refused, rewriting it, taking the reviewer’s comment into consideration, doing it again and again.

SP: Oh, I know, I know. Being on both sides of the street I’ve experienced both the situations. Would you just say a few words about your interaction with industry?

WP: Yes, our major interaction with industry was in the development of the mechanical heart. We were able to have an association with the 3M Company. At that time they had purchased the Sorrence Incorporated, the large manufacturer of heart lung machines. And that, it turned out to be a wonderful association. It lasted for ten or fifteen years and then, not having anything to do with us, the 3M Company decided that they did not want to be in cardiovascular business and they sold that business to Terumo and Terumo did not want to be involved in the mechanical heart. But we did a lot of teaching to bring the engineers up to speed so they would understand what our needs were. We’ve always liked the engineers to come into the animal operating room and even put on gloves and see what we’re talking about and how things fit, how we do things. And we’ve had a wonderful, wonderful association. We also work very closely with the company that was then called Arrow International on our LionHeart, which was again the single left ventricular support for permanent use. The Arrow International is located in Reading, Pennsylvania which is about a hundred miles away from us, and I often say there are ruts in the road because we went back and forth with Arrow so many times on that. And it was very, very helpful to us because when we go to a supplier and say to them we need five of something or seven of some part to work. If we have company behind us then we say well, you know, there’s now the potential that this is going to turn into a product for you and we’re talking in terms of hundreds or even thousands of these parts, then maybe they’d become a lot more interested in making a custom device for a university research group.
SP: I agree, although sometimes things fall between the cracks. The partnership with industry to move things along has been very helpful for this whole field.

WP: Yes.

SP: Dr. Pierce, whether we like it or not, often names are placed on the devices that we work with and I wonder if you would say a few words about the Pierce-Donachy device.

WP: Yes, this is the pneumatic ventricular assist pump that's often referred to as the Pierce-Donachy pump. [Displays device model] Jim Donachy was a machinist at the National Institutes of Health when I was down here for my two years at the Clinic of Surgery. And Jim turned out to be a can-do person. Whatever-- he was the first person to fabricate sheets and tubes from segmented polyurethane and was very helpful because he had an instinct for use for working with polymers as well as a very strong machine shop background. So I arrived at Hershey as an Assistant Professor in 1970 and the first person that I had come up to give us a hand with our project was Jim Donachy. He was, I was recently reminded, was up there four times in the first year as a consultant. And finally I asked Jim if he would consider taking a job with us. We had a drill press and we had a Sears and Roebuck lathe, and no one that really knew how to use it. And Jim was used to the facilities of the NIH where they had lathes with eighteen-foot beds; just tremendous things. Jim said yes and he came up and built a very nice machine shop. It’s all computerized and we have two beautiful Hardinge high precision lathes. But when we were trying to figure out how to build this blood pump, we wanted to when the device was activated, to have the diaphragm come down and get a very good washout and the only way we could see to do that was to put these ports at an angle, and it turned out to be not an easy feat to make this on a conventional milling machine. And I talked to Jim about it and I said, “Well, do you think you could make it, Jim?” He said, “Yes, we can do it, we can do it.” And he went in the lab and he was the first person that figured out how to put these inlet and outlet ports in. We applied for a patent through the University and they had their experts look at it and they said no, they didn’t think that the device had any future. So they didn’t want to do it. At that time, if it was developed under an NIH grant which it was, the NIH was able to look at it, and they looked at it and they said no, they didn’t want to patent it. And the day we got the letter from the NIH saying that they were basically turning the device over to the developers, that were Jim Donachy and myself, we made an appointment with the patent attorney in Harrisburg, Mr. [Thomas] Hooker, and he filed the patent on it and it had a lot to do with us being able to convince the Thoratec Laboratories to begin to make the device commercially because it did afford some protection for them. Jim stayed active in the field until four or five years ago and ended up having heart disease. Had a prosthetic valve implanted, a pacemaker. I used to kid him that I’d say Jim, you’re supposed to be a developer of these devices, not a user of them. And I’m sorry to say that Jim passed away within the past year of congestive heart failure.

SP: Well, it’s a wonderful tribute to him and your comments point out how the surgeon is really more than just a surgeon. They are a team leader, an innovator and free thinker. Well, that’s very interesting. Do you have anything else that you want to show us?
WP: No, I think that’s pretty good.

SP: Earlier in the interview we talked about [how] these devices were initially thought of to bridge a person to recovery [more] than a bridge to transplant. And now we’re at the point where a number of these devices that are available, including yours, are for destination therapy. Where do you think we are with the left ventricular assist pumps? My thinking is that we are right on the cusp of where we were with the early days of pacemakers, where there are lots of issues but there was an explosion in the implantation because of the need.

WP: Yes.

SP: I’d love to hear your comments.

WP: Well, for a number of years the cardiologists have been coming up with an additional inotropic agent and things and I think that we have now pretty much demonstrated to them that there are devices that can be used with quite a low incidence of complications and that they can be used for a number of years. The problem that we have at the present time is that these are electrically powered devices and they still have a wire going through the chest wall. And first of all, it’s a potential site of sepsis and secondly, if it does develop infection in that area, it can track inside of the device and lead to a very bad situation. So we need to move the current devices to the transcutaneous energy transport, and as I had mentioned, these became available or were developed in the 60s. So if you think of what’s happened to electronics in that over fifty years, it’s definitely doable and it has been done in humans.

SP: Dr. Pierce, earlier in our interview you mentioned the need for destination therapy related to the large number of patients each year, roughly ten thousand, that will need a device to survive. And considering the balance between the bag full of medications that people take and the advances that you and others have made in left ventricular assist pumps for destination therapy, where are we now? Are we at the cusp of large implants?

WP: I think we are at the cusp, Steve. We have now pretty much convinced our medical colleagues that we have several devices that can be used for destination therapy for a number of years with relative safety. What I see as the problem with the current devices relates to the wire that has to cross the chest wall. First of all it’s unsightly. We would like to be able to eliminate that. There’s been quite a bit of work done, as we spoke earlier, about transmitting electrical energy across the chest wall using inductive coupling technique that can be done with the current pumps that are being used for destination therapy. And I think that these devices are able to provide three and four liters per minute of circulatory support; take some of the load off the left ventricle and people are able to go about relatively normal lives; go back to work and enjoy retirement, whatever. So I think that we’re going to see much wider spread use of these devices in the near future. But I think that they are going to have to eliminate that wire, and it’s certainly something that would technically be quite easy to do.
SP: I would think that some of this is cultural as well. I mean we have large populations of people that are on dialysis on a daily basis and the community has gotten used to having the access ports. Occasionally they get infected and they have to be changed. And yet it’s very acceptable. Obviously it’s a lot easier to change an access port for an artery and a vein than it is for an artificial heart. But I think we will get there. We will get there. Well again, thank you very much. It’s just been my pleasure, my honor to have this opportunity to do this face to face and thanks.

WP: Thank you. I’ve enjoyed it, Steve.

[ Interview ends ]