SUMMARY

Dr. Miles J. Edwards begins the interview with some general information about his education and his career here at OHSU, first in the Division of Chest Diseases and later as a member of the Center for Ethics in Health Care. Then he moves into a discussion about his father, Miles Lowell Edwards, co-developer of the Starr-Edwards heart valve.

Dr. Edwards gives some background on his father’s upbringing and education in Oregon, as well as on his early career as an engineer and inventor. He then proceeds to relate how Dr. Herbert Griswold introduced his father to Dr. Albert Starr, a surgeon working at the University of Oregon Medical School. He describes the early development of the heart valve, discussing the initial testing on dogs and the first human patients to receive the prosthesis.

Edwards then goes on to talk about the manufacture of the valves, and gives a short history of Edwards Laboratories, the company his father founded to produce the devices. He also discusses some of the engineering aspects of the development, including the novel stress tests that were designed and the biomaterial properties that were investigated. He mentions other early attempts to design artificial heart valves, such as the Hufnagel valve, and elucidates the differences between those early designs and the Starr-Edwards valve. He considers why the Starr-Edwards valve looks so radically different than the natural human heart valve, and notes that his father was able to approach the problem from a strict engineering standpoint, unhindered by detailed anatomical knowledge of the human heart. He had developed several types of valves for mechanical purposes earlier in his career, but the heart valve was a departure from anything else he had designed.

Edwards also addresses his father’s motivation for entering into this biomedical engineering partnership with Dr. Starr: stricken as a child with rheumatic fever, Lowell Edwards was well aware of the need for a new treatment for rheumatic carditis. He was also driven by the knowledge that his other notable invention, the booster pump for airplane fuel lines, had been used in World War II, possibly with great loss of life to enemy combatants; his Quaker upbringing influenced his attitude toward war and the taking of human life. He was so devoted to the success of the heart valve project that he used his own considerable fortune, made during the war years, to finance the research.

In conclusion, Dr. Edwards mentions other researchers who played important roles in the development of the valve, especially Arnie Solberg, a lab technician who worked very closely with Lowell Edwards.

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Interviewed by Annette Matthews
August 7, 1998
Site: OHSU
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MATTHEWS: So what we usually do—the oral historians have trained me to do this, now—is to start kind of biographically about you.

EDWARDS: About me?

MATTHEWS: Yeah. So where were you born and raised?

EDWARDS: Portland, Oregon. I was born in Portland, I lived here till I was eight years old, and then we moved to Longview, Washington, where I finished high school. Then my family moved back to Portland and I moved back to Portland. Except for a tour in the military service and a year of fellowship, I've lived in Portland ever since. I went to medical school here, too.

MATTHEWS: At OHSU?

EDWARDS: OHSU, right.

MATTHEWS: University of Oregon, I guess it was then.

EDWARDS: It used to be called the University of Oregon Medical School.

MATTHEWS: How did you decide to go into medicine?

EDWARDS: Well, when I was a kid I had an illness. It turned out later, when I learned more about it, that it could have been very serious, but—and a very nice doctor took care of me. And I was about fourteen years old or so. It wasn't exactly then that I decided I wanted to go into medicine, but there was one day when I was in my summer vacation between my junior and senior year of high school in Longview, I was just doing some odd jobs and mowing lawns and things for people, and it just hit me that I'd like to be a doctor. It really was the beginning of that as my motivation. I had my ups and downs after that. In college I sort of played around a lot the first year and almost flunked out.

MATTHEWS: Where did you go to college?

EDWARDS: Willamette University. There's kind of an interesting sidelight, if you have time for it, but I always like to repeat the story. An older graduate student in my fraternity house kind of befriended me and knew I was sort of fooling around and not going to make it to medical school, and he sat me down one day and gave me a nice, kind of fatherly talk about why I should straighten out and get my studies done. His name was Mark Hatfield.

MATTHEWS: Oh, my goodness.

EDWARDS: And it was a long time before he was a famous man or even a political figure. But he and I still, when we've met, have remembered that conversation. And it was one of the turning points. It turned me around from almost throwing it all away, and I went on and eventually got into medical school, went through the then University of Oregon Medical School.

I stayed here a long time. I took a rotating internship in 1950—well, I got a master's in physiology also, and it was in respiratory physiology. Right here, where we sit in this department, used to be the physiology department. And so I got my M.D. and M.S. in five years instead of four years for just the M.D. And then I went on into—took a rotating internship and an internal medicine residency.

And as I went along in internal medicine residency, I saw myself specializing, subspecializing in—having had that respiratory physiology background in when I went through physiology, I was interested in pulmonary medicine, so I eventually trained to become a pulmonologist.

So I went in the military service for two years in '61 and '62, stationed at Fort Benning, Georgia, and I ran a chest clinic down there at their hospital. Then I came back to San Francisco and took a year of fellowship there at the University of California San Francisco Cardiovascular Research Institute. I came on the faculty as an assistant professor in 1964.

The Pulmonary Division was very, very small then. In fact, at one point I became the only member of it. Of course, I became head of it [laughter] because I was the only member of it. And I was head of the Pulmonary Division from somewhere around 1967, and it eventually grew, and I stayed head of it until 1983, when I stepped down as head of the Pulmonary Division. But I continued as a member of the division, did critical care work, until 1991, when I retired from the Pulmonary Division and retired from my faculty position. But I stayed on at a part-time basis, and I still saw patients, and had a practice until 1996, when I fully stopped, retired from my practice.

Since 1991 I got interested in ethics, because, you know, working in the ICU we had a lot of life and death issues and situations where we were continuing life support and wondered why, whether we should or should not. So I took training in ethics and then joined the ethics center in 1991, I guess it was, or 1992.

I took training—it was sort of a correspondence course out of the University of Washington in Seattle—and I took a year's course, wrote up some cases, attended some conferences up in Seattle, and got certified as a medical ethicist in 1992. And so I've been doing that some and teaching PCM for medical students, that sort of thing, since.

MATTHEWS: In your ethics work do you concentrate on end-of-life cases?

EDWARDS: Well, that was my original interest. I've gotten awfully interested in the impact of managed care on the doctor-patient relationship; it's my biggest interest now. But end-of-life decisions, when to stop life support and when to continue, things like that as well.

I'm not all that much into the genetics and reproductive side of things. I have to delegate that to somebody else. I mean, I have opinions, but I haven't made a study of it. My big interest has been that. And I'm interested in the assisted suicide debate. I have publicly opposed assisted suicide, for a number of reasons we don't have to go into, so I've been involved in that, too.

MATTHEWS: I know Dr. Nelson, who I work for, has done several surveys of Oregon physicians on their opinions.

EDWARDS: Yeah. I think I've participated in one; I think I filled out some of her forms.

MATTHEWS: Yeah. There's another one coming.

EDWARDS: Oh really? Okay.

MATTHEWS: It's in the works.

EDWARDS: She's a nice gal.

MATTHEWS: Okay. So the next part of the questioning is on valve development and the history of valve development since 1958. I always ask people how medically important was valve development?

EDWARDS: Do you want any biographical on my dad at all?

MATTHEWS: Yeah, I think that would be good, too.

EDWARDS: Well, he was born in 1898 in Newberg, Oregon. He was the son of Quakers, the people that sort of founded the community, and he went to—well, it's now called George Fox, but it used to be called Pacific College, and he got his engineering training at Oregon State.

MATTHEWS: What kind of engineer was he?

EDWARDS: He was trained as an electrical engineer, but his actual work was in hydraulics, pumps and things like that. He was an inventor. He did a lot—he must have had sixty patents in his lifetime. The most outstanding one was one we'll be talking about, the heart valve, but there were many others. He developed a hydraulic log barker for Weyerhaeuser that used jets of water to peel the bark off logs. And then he developed pumps that were in military aircraft during World War II. In fact, at the end of World War II his pump was in 90 percent of U.S. military aircraft. I mean, he had been a pretty successful inventor long before the heart valve came along.

Well, getting past the biographical—I was through medical school when all this happened, so I was a doctor, an internal medicine resident, actually, here on the Hill, and my dad was sort of looking for something to do. He had had as a boy—I was told he had rheumatic fever, and he had a small heart murmur. And with his Quaker ancestry, which is sort of a religion of people who were pacifist as far as war was concerned, he was always sort of bothered by the fact that his pumps had helped fly planes that, of course, caused people on the other side to be killed, and that weighed on him. Not that he had a direct role in it, and, of course, he saved other lives by developing pumps that helped our planes fly, but, you know, he nevertheless felt like he wanted to do something that had medical significance. And with his hydraulic expertise, he wondered about artificial heart or valves or something like that.

He was a personal friend of Dr. Herbert Griswold, who was then chief of cardiology here.

MATTHEWS: The Griz, is that what they called him?

EDWARDS: [Laughter] The Griz, right. He and Herb Griswold and another doctor, Jarvis Gould, were personal friends. Dr. Gould's been gone for a long time, died many years ago, but he was also here, and my dad knew him personally. Dr. Starr had just come on campus as a new faculty member, starting a division of cardiovascular surgery, cardiothoracic surgery; and Dr. Griswold, I think, arranged a meeting between the two of them, Dad having the inventive skills, the engineering skills, and, of course, Dr. Starr having the surgical skills.

MATTHEWS: So how did your dad meet Dr. Griswold? Did you introduce them?

EDWARDS: I don't remember how that happened. I don't think I had any part in it. I was here, I knew Dr. Griswold, and I remember my dad saying that he had gotten acquainted with Dr. Griswold. I don't remember how exactly that did get started. Dr. Griswold's still living and might be able to tell us. He only lives up here on the Hill. So if you want to track that down, he might be able to tell you. But anyway, Dad met with Al

Starr, and they talked about maybe developing a heart valve. Dad had some ideas about how it would work and quickly came up with a ball-and-cage prosthesis idea.

MATTHEWS: Now, was the initial idea—there's a story someplace that actually the initial thought on your dad's part was to make a completely artificial heart.

EDWARDS: Yes, it was. That was the first idea. He didn't have the ideas—he wasn't sure what was realistic medically, and, in fact, that is what he first thought of. He had worked on what's called a ballistocardiograph before that—it wasn't something that went anywhere—which was to be a diagnostic device in which a person lay on a table and the jiggles, you know, of the table, just from the heart pumping and things, would possibly have some diagnostic or physiological significance. That didn't go anywhere, but that was earlier, and Dr. Griswold and he had discussed that. So there were other projects that Dad had gotten involved in before he got into the heart valve, which was the much more successful outcome.

About where rheumatic heart disease was in those days, I do know that people with severe mitral disease, regurgitation stenosis, aortic valve disease, regurgitation stenosis, would just go in and die. They had a mechanically impossible situation, and they either couldn't get it through a valve or they refluxed back, you know, and they had inefficient cardiac pumping. And there was clearly a need for a new procedure; they used to do procedures to try to fix the valves as best they could, but they were still not very successful. They did fracturing of stenosis and things like that. They called them commissurotomies. But the idea of valve replacement really would be a step forward.

So Dad got to work designing a model which would be tried in dogs first. When I was a second- or third-year resident in medicine here—and, of course, I was married and living away from home, but in close touch with my parents—Dad was starting to work on this valve and make them, and Starr would put it into dogs. At first the dogs died and they had a lot of problems. Clotting was the big problem. They had suture line which generated clot, and Dad came up with the idea of a shield that would cover the suture line.

MATTHEWS: The Silastic shield?

EDWARDS: Yeah. That was Dad's idea, but Starr pointed out the need. And finally, in about—I'm guessing, but I'd say 1959 or 1960 they were getting dogs to survive. They realized that the dogs have a more active coagulation system than humans, more prone to thrombotic complications than humans would be, so the thought was that they could do humans in that respect, at least, more safely than they could do dogs.

So I believe it was the fall of 1960. The reason that date sticks in my mind was that I got called in to the Army in January of '61, and I was just finishing up a fellowship, a pulmonary fellowship, here, sort of for an addendum on my internal medicine residency. When I left in January of ’61, it was about three months after they had had their first success—well, they had started to put valves into humans, and those were all mitral valves. And they took the very worst of cases, people who were dying, clearly dying, without surgery, so that they could do an experimental procedure, which, of course, it was then, and do it and justify doing it. And, of course, if they saved them, fine; if they died, they were dying anyway.

I believe of the first eight cases they had four deaths and four survivors, but the survivors were really, truly saved. They were brought back from the edge of death. I mean, it was a remarkable accomplishment. The very first death I think was an air embolus, and I remember hearing about it, and they felt so bad about it. Apparently, just as they were getting the pump to work successfully, it sucked some air in and it went to the brain, and that was the end of the patient. That was one of the early ones.

MATTHEWS: That was the first transplant.

EDWARDS: Maybe you already heard about that.

MATTHEWS: I read it in the paper.

EDWARDS: But they did finally start having successful heart valve transplants. The thing that was so nice for me was I got called in the military and went down to Fort Benning, Georgia, and I was working in a hospital with young doctors and reading the medical literature, and people were talking about this heart valve in Oregon, and I said, “Yeah, I know. That’s my dad” [laughter]. I always said that with a great deal of pride.

MATTHEWS: So people on the floor were talking about it?

EDWARDS: Oh yeah, everybody was talking about it. I mean, it was something that was big news then.

MATTHEWS: What made it such big news?

EDWARDS: Well, it was a breakthrough; it really was a breakthrough in advancement, the science advancing in this area, that they could now take patients who had terrible rheumatic heart disease—usually, at that point in time, mitral disease, and put in the valve. And, of course, as they gained success, it ceased to be the experimental procedure, it was something you could think about taking people earlier in their disease and justify doing it, not just somebody who was about to die anyway. So they were beginning to expand their field in doing that.

I was away for two years then in the military, but, of course, in close touch with my parents and aware of that he and Dr. Starr did a whole lot of surgeries; and it became well known. They had to manufacture these, and so Dad started a company. My parents had moved to southern California in the fifties—even though they were native Oregonians, they moved down there—actually, before this all happened, even. But they had my sister and I, the two children, and we both lived in Portland here. In fact, my sister's husband is also a physician and on the faculty here, in fact. And so their grandchildren, their children and grandchildren, all live here. And they had a place up on the Sandy River that they came to in the summers, and Dad did a lot of his work in a shop on the banks of the Sandy River up by Brightwood. So a lot of his work was done there, and, of course, he was in close touch with Al Starr when they were making the valve.

Well, anyway, I went away to the service in 1961, and heard about it. They then, sometime later—and I don't know exactly when it was, early sixties—they realized that the aortic valve—some people had aortic valve disease. Of course, they had to design a valve from the same principle but a bit smaller—at least I think it's a little bit smaller. The aortic valve had to be more durable because of the greater pressures involved in the force with left ventricular ejection, a lot more rapid flow, more turbulent flow; but they were successful. Basic same design except fitting it to the anatomic dimensions of the aortic valve ring. So they were starting to be able to do aortic valves. And, of course, they had to anticoagulate all the patients with that kind of valve. But they were remarkably successful.

And from that an industry developed, and other companies formed. One man that worked for my dad was a man named Don Shiley, and Shiley split off and set up his own company, and the Shiley Company has become…

MATTHEWS: Bjork-Shiley.

EDWARDS: Yeah. So Shiley was somebody who had worked with Dad in the early times.

MATTHEWS: Down in Edwards?

EDWARDS: Down in Santa Ana, California, where Dad's company was developed. It was called Edwards Laboratories, eventually was bought out by American Hospital Supply about 1967, I believe. So Dad was then fully retired and didn't have any—he still had hobbies and worked with things, but he wasn't in charge of the company anymore, but it carried his name. Later, Baxter bought it from American Hospital, and it's been a division of Baxter.

MATTHEWS: I noticed on the Baxter Web site, you go out and you'll see all these various—there were a lot of "Edwards" things. Are these things they worked on, or did they buy the name Edwards?

EDWARDS: Well, the name—there is an Edwards Laboratories branch of Baxter in the same place where my dad started, and it's the same building. They've probably gotten bigger. They have their own people. I don't have any direct contact with them to know quite how they—but my dad's picture still stands in the front, I think, of the place as the person who started it all.

The Edwards division of Baxter does other things, like, for example, the Swan-Ganz catheter is produced by them. I think they have a plant in Puerto Rico where they actually make them. My dad knew something about the Swan-Ganz catheter, but he wasn't involved in the designing of it, I don't think. He didn't have any personal role as an engineer in developing the catheter, but he was aware of it. So his company has taken that on, and, of course, they've also gotten into putting porcine prostheses in for some patients, pig valves, which have the advantage of not having to require anticoagulation.

MATTHEWS: Oh, really. So no anticoagulation is required?

EDWARDS: That's my understanding. You could check it out with the surgeons because they know more about it than I do. Dad didn't have any real role in that, either, but his company did, and he was aware of it in his lifetime, of the pig valves.

So pig valves are sometimes used, but valve prosthesis has been remarkably durable, and there have been no major catastrophes connected to it, which is really remarkable for the testing they did, because Dad was trying to simulate, you know, forty years in a patient with short-term testing; and you have to beat it faster and put pressures on it that are like what are happening, but you don't have blood, you have water or saline or whatever it was. So, of course, you didn't want balls breaking down and embolizing or becoming leaks, hemodynamically messing things up inside the patient.

MATTHEWS: So they had to engineer not only the valve, but they really had to engineer the testing to test the valve.

EDWARDS: Oh yeah. And Dad had to come up with the original materials of the balls, because the balls had to be biologically inert so they didn't collect clot or something. They had to be durable, because they take a certain amount of pounding, and have it last for a lifetime of a person. So, I mean, it was really big, heady stuff, and it could have been disastrous. I mean, granted, it could save lives and then be disastrous, but, you know, it could still be disastrous. But I don't think they ever had any major problems with his original valve.

MATTHEWS: Do you know, in terms of materials of that time—that's one thing I'm interested in, are these kinds of biomaterials. Had those been used other places, like in orthopedics?

EDWARDS: You know, I don't know. I think Silastic was a material they used for the ball. They used, of course, metal for the cage. I'm not sure about that. I know Dad had a lot of knowledge of the materials that were needed. He knew about some of the plastic materials, or rubber, or whatever, and had a skill in that area, so he knew what he could work with. Of course, he hadn't worked with biological systems before. And, of course, they needed to have something that would last. But I don't know the details of that.

MATTHEWS: In his early career did he work—I had someone tell me that he worked as a water engineer for Portland, the city of Portland.

EDWARDS: No, to my knowledge, he never worked for the city of Portland, but he did work for what's called Bingham Pump Company. I don't even know if it's still around, but when I was a small boy, he worked for them, and we lived in Eastmoreland in Southeast Portland. They just made pumps. They may have had pumps that the city of Portland used, but he never was employed by the city of Portland.

Then he invented the log barker as one of his—he was always working at home at night. He always had a lathe, machinery, he was always working on a project, making blades and working with a lathe and doing things that, you know, most dads don't do. And I grew up with that, with him always working on something like that.

He developed a jet, a water blasting thing, and the force of the jet would blast the bark off of logs so they could cut it into timber, and so forth. He got a job with Weyerhaeuser and resigned from Bingham Pump here in Portland in 1937, I think it was—I was seven years old—and we moved up to Longview, where he became plant engineer for Weyerhaeuser Pulp, the pulp division of Weyerhaeuser.

But then World War II came along, and he had been working on a pump: he anticipated that airplanes, that military craft—or civilian craft, for that matter—would need to rise rapidly from ground level to high altitudes as their engines got stronger. And they needed pumps to keep—the fuel would be at sea level, and suddenly the atmospheric pressure would drop remarkably, and the bubbles would form and clog the line. So he thought, "They're going to need a pump to separate the bubbles out from the liquid fuel and keep the fuel flowing." So he anticipated that problem and worked on it. He didn't know World War II was coming, he just figured that that might be a handy thing to work on. So he worked on that for several years in the thirties, and when World War II rolled around…

MATTHEWS: In the evening, at home, the shop?

EDWARDS: Yeah, you know, when he wasn't working at Weyerhaeuser in Longview. When World War II rolled around and we had that problem, he had just the solution. So he was—he became a very successful engineer. He had the patent on it and everything. They called it a booster pump. It was in the fuel line to keep the fuel flowing. And it was in great demand in the military—military aircraft were fighting in the war and the planes need to get off the ground and not have the lines clog and crash. So he had just what they needed.

I remember we used to go up to Seattle, and he would go to Boeing. He never was employed for Boeing, but he eventually got connected with a company called Thompson Products, which was based in Cleveland, Ohio; it is now TRW, Thompson-Ramo-Wooldridge, but they used to be called Thompson Products. He became a consultant engineer—this was during the Second World War—with them through the development of this pump.

So that was maybe his second biggest accomplishment, and at that point in time, by far his biggest accomplishment. It was ten years, or more—well, fifteen years before he really got going on the heart valve. I mean, this was way before that. So he had had a very successful career as a hydraulic engineer.

MATTHEWS: Do you think the shape of the heart valve—there are lots of different stories in the literature of where they came up with that. Some people say it's from a bottle stopper; some people say that Hufnagel was also working on a valve and that it was the Hufnagel valve.

EDWARDS: Well, there was a Hufnagel valve before this came along, that was inserted in the aorta, and it was there to treat aortic regurgitation, and it was a partially successful way to do it. It would prevent the reflux of blood that had gotten past that part of the aorta. It was always in the descending aorta, thoracic aorta, so the low pressures in diastole, which, of course, would be going back into the heart during diastole—you'd still have the bounding arteries in the upper extremities and head and neck, because they were before the Hufnagel valve, but the Hufnagel valve had decreased the total amount of regurgitation by a certain amount.

And it had a ball that went back and forth in a plastic cage. It was somewhat the same idea. I don't know about the materials of those valves or the balls, whether they were the same kind of thing. I think they were different. It was more like a ping-pong ball. I don't remember how it went, but when I was a medical student, I can remember listening to one and hearing the click, click, click, click, click, click of…

MATTHEWS: Of the Hufnagel?

EDWARDS: …the Hufnagel valve. So the Hufnagel valve did antedate the Starr-Edwards heart valve by some years. I don't remember how many.

MATTHEWS: Not very many.

EDWARDS: Not very many. So Hufnagel was a surgeon, and whether Dad knew of Hufnagel's valve—Griswold would have clearly known, or Starr would have known of it. How that entered their thinking about how to devise this valve—they really are quite different, because this valve was a cage, open cage. It had to account for the contractility of the ventricle so it didn't impair systole, but it had to block regurgitation into the left atrium during systole and, yet, get flow through the other way.

[End of Tape 1, Side 1/Tape 1, Side 2]

EDWARDS: Dr. Starr might be able to say something about that, or Dr. Griswold. They're both still living and around Portland, and they might be able to tell you. I don't remember. I think my dad would have thought of this design independently. And the design is sufficiently different—rather than being an insert in a line, it's a protrusion into the ventricle with—you know, it's a different design. It is a ball in a cage, and so forth, but it does have different characteristics. But I don't know how Hufnagel—I can't say.

MATTHEWS: If it was an influence or not.

EDWARDS: I'm not sure it was. I never thought it was, and I knew about the Hufnagel valve. I mean, I knew about the Hufnagel when I was a medical student and a resident.

MATTHEWS: How common was that? Because you see it talked about.

EDWARDS: Not very common. I don't think it was very common. It was a very drastic surgery. They were doing bypass by then, so they could do that. They had to do bypass, because it was inserting it into the aorta, and, you know, you can't shut that down very long. And you'd have to have a hemostat; you'd have to have control. So it couldn't have been going on very long, because they weren't doing open-heart surgery or bypass procedures until in the fifties sometime.

MATTHEWS: I think '58 is the official date.

EDWARDS: I think that's right. When I was an intern resident, beginning resident, so that's just a year or two before.

MATTHEWS: When you read about the Hufnagel, there are a lot of comments in the literature that people couldn't do it, because for some reason they had to do it so quickly.

EDWARDS: Yeah, because the brain dies fast and the kidney tissues get anoxic and you have to keep blood contained. So it would be a tricky thing to do. I don't know how they set that up and did it, really.

MATTHEWS: The Silastic shield, that was one thing—do you have any idea why they didn't put that into the first human patient, as opposed to the unshielded valve?

EDWARDS: I thought they did put that in the first human patient. They didn't?

MATTHEWS: No. For some reason they used the unshielded valve in the first human patients.

EDWARDS: Well, you know, at some point they learned that that suture line was a source of clotting. I thought it was in dogs, but it might have been in humans.

MATTHEWS: The clotting was in dogs, and they used the Silastic-shielded valve in dogs with good success, and a lot of dogs lived.

EDWARDS: But they put them into humans without that?

MATTHEWS: Yeah, then they didn't put it in a human.

EDWARDS: That doesn't make sense to me. I mean, I would have thought that would have been standard operating procedure to do that. I don't remember that detail; I just assumed they'd always done that. Starr could tell you, of course. He knows intimately. Have you talked to him?

MATTHEWS: I tried to talk to him Monday, actually, and there's another video of him talking about the valve that he wanted me to look at before.

EDWARDS: Well, you might want to look at that. You know, some of that stuff may be in this stuff that I'm loaning you to look at.

MATTHEWS: I was going to ask you also, in terms of your work as an ethicist, one thing I was interested in is how they chose the early patients and maybe even kind of how ethical was it to be placing an experimental technology?

EDWARDS: Well, I touched on it a little earlier when I said we were dealing with people dying anyway. And, of course, I'm sure there was an informed consent followed, that patients knew they were dying anyway and they were desperate to live, and they probably were told that it was experimental but that it offered hope. People generally will go for that.

And ethically that makes a big difference, because if they are not dying anyway, then to do something experimental which may cost them their life is obviously not ethical. First, do no harm. If, however, they are sufficiently ill, death is imminent and this is their one chance of survival if it works, then—and I'm sure they followed rules of informed consent, telling them what they were going to do, the patient assuming the risk and in the right mind, then that would be ethical. And I think that's the way they did it.

MATTHEWS: So it was really a matter of life and death.

EDWARDS: Sure. Their first patients were a very high-risk group, ones that were just on the verge of dying. In fact, you can read the story about Amanda Dao, a Chinese woman—it's in there—about how she was dying and how she was saved by that. It was big stuff.

MATTHEWS: Yeah. It is amazing to think it was nine, fifteen years of survival.

EDWARDS: And, you know, nowadays it's part of the common-place medicine, but let me tell you, when I was a medical student at your level, or when I was an early resident a few years later, this was revolutionary. I saw a lot of people, when I rotated on cardiology, who had severe valve disease. And, of course, eventually I saw a lot of people with congenital heart disease, some of whom have had a valve as part of their correction, too.

MATTHEWS: In terms of rheumatic fever—you know, that was really, obviously, a major use then.

EDWARDS: Yeah.

MATTHEWS: When did that become less of a problem?

EDWARDS: Well, one of the reasons it became less a problem was the advent of penicillin, because rheumatic fever was a complication of streptococcal pharyngitis, and people had strep throats periodically. In fact, I remember I told you at the beginning that my interest in medicine came from an illness I had, which was acute glomerulonephritis, also a complication of streptococcal infection, where it's thought that some antibodies develop that attack the kidney after a strep infection. And I'd had a strep infection in high school, and I was very sick with acute glomerulonephritis. And years and years later in medical school I realized how lucky I was that I hadn't died or hadn't gotten chronic kidney disease.

But anyway, rheumatic fever and acute glomerulonephritis are two post-streptococcal syndromes—they start developing after a streptococcal infection. Well, with the development of penicillin and much more prompt treatment of strep throats, the incidence of both glomerulonephritis and rheumatic fever diminished greatly, so we didn't have so many after that. I don't know how many we have now. I haven't heard of one in a long time, but they may be around.

MATTHEWS: Well, there was actually a big epidemiological study of people with heart valves, and it's still well over 20 percent of people who have heart valves had rheumatic fever.

EDWARDS: Yeah, who had that as a reason for their heart surgery.

MATTHEWS: That's long-term.

EDWARDS: Sure. One of the issues when the cardiologists try to determine whether a valve is the answer is whether they have rheumatic carditis. In other words, if they have muscle impairment and that's their bigger problem, valve correction may not be the answer. But if they do have good myocardial function, heart muscle function, and it's the hemodynamic problem of the leaky valve or the stenotic valve, then valve replacement is very much a solution to the problem. That's more the kind of stuff cardiologists will know more about than I do, but it was a big solution.

MATTHEWS: Do you think the partnership that your dad and Dr. Starr had was unusual for the time, the engineer and the physician?

EDWARDS: Yeah, it was unusual—I mean, at least I think it was pretty unusual. I think it's more usual now. But, you know, the beginning of biomedical engineering was really starting in those years. It was about the same time that dialysis was getting started, for example. It was a very limited field. There wasn't much biomedical engineering before then—we're talking late fifties, early sixties. It was about the same time that Belding Scribner, for example, developed the first dialysis machine in Seattle, and that kept a lot of people alive with chronic kidney disease, kidney failure. Ultimately, transplants came along and sometimes people get hemodialysis; people get transplants. So biomedical engineering required the alliances of engineers and physicians, surgeons. So there was that kind of a combination.

MATTHEWS: Do you think that the war had anything to do with people being more likely to make these kinds of partnerships?

EDWARDS: Well, you know, wars have a way of developing technology that then finds other uses. Now, whether this had any connection with the war, I don't know of a direct one.

MATTHEWS: Even just the ability to make the relationship. Why do you think they made that partnership, if it was kind of unusual for the time?

EDWARDS: Well, I know my dad's motivation was to do something of value medically. He clearly had to work with people in the medical profession to do it, surgeons in particular, cardiologists. So they came together, obviously bringing different kinds of skills to a difficult question. Clearly, Starr couldn't have done it without Dad, and Dad couldn't have done it without Starr, and they both realized their own contribution and the need for the other person's contribution. So it was a good alliance, and I think other engineering-medical combinations have realized the same thing, that they need each other to make a meaningful advance in tackling some problem.

MATTHEWS: How was their working relationship? Did they get along well?

EDWARDS: Well, they seemed to get along well. This is not something maybe you should publish, but they're very different personalities.

MATTHEWS: Do you want me to turn this off?

EDWARDS: Yeah, why don't you turn it off for this.

[Tape stopped.]

MATTHEWS: Dr. Loriaux, the preceptor for this course, had the question: why is it the Starr-Edwards valve and not the Edwards-Starr valve?

EDWARDS: Well, that's a good question. I don't know what you should write about that. Dad developed the laboratories where he made a lot of money [laughing] from the industry that he developed.

Dad didn't care. He wasn't out for fame and glory, really, all that much. He wanted to do something useful.

MATTHEWS: One thing I was wondering is, the airplane or water pump valves that your dad worked on, did those look at all like a ball and cage?

EDWARDS: No, they were very different designs. He had pumps that had propeller blades that were a curious design. I don't know whether there are any pictures of those in there, probably not. But he developed things that looked more like a fan that were, oh, in-lines to—we called it an impeller blade that was used to separate the gaseous from the liquid fuel. Some other pumps had other designs. No, this design was very unique, and there was nothing quite like it in his prior work. But he did have a very good sense of hydraulics, and that's what he did, even though his training had been in electrical engineering at Oregon State.

MATTHEWS: So it's more like mechanical engineering.

EDWARDS: Yeah, it's more like mechanical engineering.

MATTHEWS: One thing that Dr. Starr has made a comment about was that even he found that the valve looked almost unnatural. A lot of people make a big deal about how it doesn't look like a heart valve.

EDWARDS: Right, it doesn't look like the way God made it.

MATTHEWS: Did he ever talk about that?

EDWARDS: Well, I think there was a concern about that, but they felt that they could do what had to be done better this way, and I think history has proven that true. You know, if you have a hinge system, you have a lot of moving parts that have potential for going wrong or wearing out or something, whereas the ball and the cage isn't the way the valve was in nature, but it still accomplished the purpose most effectively.

MATTHEWS: How do you think they made the jump? Because there was a big congress on heart valves right at that time, and everybody—I mean, it was like the first airplanes, when you saw those funny pictures of how people were going to fly? Some of the valves look kind of like the first airplanes—I mean, that strange and complicated. And this is so simple, but doesn't look like the natural thing. Do you have any sense of how they made that jump?

EDWARDS: Well, I think my dad probably is an inventor who came into this from years of thinking of pumps and hydraulic situations. I think Dad probably quickly realized that the ball-cage was a better way to go than duplicating the valve that exists in nature in people and animals.

MATTHEWS: So it wasn't really, for him, a problem to make the jump.

EDWARDS: I don't think for Dad it was a really big jump, because he wasn't used to the anatomy anyway. He was thinking, "What's the need? The need is to prevent the regurgitation back into the right atrium. What's the need, also, to give room for the ventricle to contract, have it open so that it doesn't interfere with diastolic filling of the ventricle?" So I think he saw the valve—I mean, it just seemed like the right mechanical design. So for Dad, as an inventor, I don't think that was a big problem.

MATTHEWS: It was more focusing, then, on the clinical and the mechanical problem.

EDWARDS: Right, that you could do it better this way than the way of duplicating what's there in nature.

MATTHEWS: Do you remember other people at the time—we talked about Hufnagel—who he might have mentioned to you were working on valves?

EDWARDS: Well, DeBakey you mentioned, and there's another one whose name isn't there, but Denton Cooley. Cooley and DeBakey were people that my dad knew. They were both in Texas, I think Houston. Dad was personally acquainted with those people. The first valve really was the one that Dad and Dr. Starr did, and the ones that followed were, to a large extent, from people they trained or who started out with Dad and then, like Shiley, for example, split off; and there were other people who also did, names of which I forget right now. They might be in some of these things I'm passing out to you that you can read.

MATTHEWS: The valve lab. You talked about the lab in his garage, or was it his cabin on Mount Hood?

EDWARDS: Yeah. I told you about that. Why was Edwards in California?

MATTHEWS: That's the next question.

EDWARDS: Well, I think they just wanted more sunshine, and they were nearly sixty years old. They were Oregonians. My dad and mother were both born and raised in Oregon, and their children, my sister and I were both here. So they sort of went with the birds. They were down there in the winter and up here in the summer. They had a home in Santa Ana, near Tustin down in Orange County. He developed his lab down there, but he did his original work up here.

They spent the summers up here; they'd come up here in May and stay through October or something, so they spent four or five months a year. They had homes in various places. They had a home up on the Sandy. That's where he did his work on the valve. Later, when he was a bit older, they moved into Portland, and by the early seventies they lived down at the Grant Tower down here, next to the Red Lion, or now the Double Tree, there are those three towers. They lived in there for years. That's where they lived in the summertime. So I think they went because of the sunshine.

We had lived for a while in southern California during World War II. I hadn't told you that. I mentioned we went back to Cleveland for a while, where he worked with Thompson. But he also worked with a company called Western Gear in Lynwood, California, down near Compton and between Los Angeles and Long Beach, and we lived there for a while, and I spent my freshman year of high school there. Even though we had a home in Longview, we moved down to southern California for a while. I think my parents liked the climate—it wasn't nearly as smoggy then [laughing]. It was 1957. I was probably a first-year resident. About two years before he did the heart valve. Their home was here, and they moved to California, moved to Santa Ana in '57; but he was up here in the summers, and that's when he met Al Starr and started working with him.

MATTHEWS: So he had moved down there before?

EDWARDS: Yeah, they had moved down there before, and they lived there until 1981. Dad's health was failing, he was very old, and he died here—well, he was in the nursing home, eventually, down at the bottom of the Hill here, that Parkview, or whatever it is. He had a bowel obstruction, and they operated on him, and he died at St. Vincent's in April of '82. My mother is still living. She's ninety-two.

MATTHEWS: How old was your dad when he died?

EDWARDS: He died at age eighty-four, so he lived a good, long life.

MATTHEWS: Is your mother in Portland, here?

EDWARDS: Yeah. She's down at the bottom of the Hill, here. She's down at the Terwilliger Plaza. Her mind is failing; she's getting a little forgetful. I spent a lot of time with her.

I see the names McCord, Herr, and Vetto. I don't remember Dad working with Mark Vetto. He did work with Rod Herr and Colin McCord.

MATTHEWS: Do you know other people who were in the dog lab or helping them in planning the valve?

EDWARDS: Starr could tell you better. One person who worked with them was not a doctor: Jerry—he was a technician that was working with them. I can't think of his last name now. He still works around here. There were a lot of people working in the dog lab. You know, I never had any direct connection with all that. I was back here on the faculty by then—well, I was here as a resident, and then I was gone, and then I was here on the faculty in '64. I was gone at the beginning of '61, and the beginning of '64 I was back. But when I was here as a resident, I was busy being a resident, and I just sort of had a passing interest in all this, but I had no direct role in it myself.

MATTHEWS: We talked about the first recipient, and we talked about other technological keys. Financing: in terms of the early valve, a lot of people have said that your dad basically financed a great deal of it.

EDWARDS: Yes. He was a fairly wealthy man from his success with the valves in the military aircraft, and so he basically financed the thing. I don't believe they had federal grant support. I think he did it out of his own personal resources. He was a multi-millionaire. He was a very, very wealthy man, way even before he did the valve, and he could easily pay for whatever they had to do.

MATTHEWS: I noticed in some of the articles his thank-yous for materials donated or purchased from various companies.

EDWARDS: And I'm sure that he worked with companies who made materials, and whether they saw something good coming here and were able to get in on it, I don't really know.

MATTHEWS: The only other place I've heard of that gave support was the Oregon Heart Association, which bought the two first oxygenators.

EDWARDS: Oh, he did a membrane oxygenator.

MATTHEWS: I hadn't heard of that.

EDWARDS: Well, he developed a membrane oxygenator which is still in use. There may be some comments about that in here, in some of these things. That's something that he designed and worked on later, probably in the middle sixties, late sixties. I think it's been pretty successful. He worked with a man named Max Liston who—and there is listed the Edwards Oxygenator, or maybe Lande-Edwards Oxygenator?

MATTHEWS: Lillehei?

EDWARDS: There is a Lillehei, but that wasn't who that was, I don't think.

MATTHEWS: He did cross circulation.

EDWARDS: Yeah.

MATTHEWS: Okay, that's about it. Can you think of anybody else I should talk to?

EDWARDS: Well, you've got some good people here. Jim Wood, the bottom one, there, I know well; he would know a lot. Ed [Oakies?] would know a lot; Gary Grunkemeier, Herb Griswold would know a lot. DeBakey and Cooley are, of course, not here; they're in Texas.

MATTHEWS: I'm actually going to go visit them.

EDWARDS: Oh, are you? You're actually going to go visit them?

MATTHEWS: Yeah.

EDWARDS: Good. And Ed Braunwald would be excellent. And who else would be good? There's a man named Arnie Solberg who was Dad's technician or lathesman or something, worked with Dad, knew Dad very well, went through all this stuff with Dad. He's still alive, I think. Arnie has been in bad health but he comes up here for testing.

Arnie Solberg would be a wonderful guy to talk to, because Arnie worked with Dad more closely more than any other person in the lab—I mean in the mechanical stuff. He would know more than anybody and was very close to Dad all the way. His name may appear in various places. He did live out near McMinnville or Amity or someplace out southwest of here. I'm not sure if he's still there or not or whether he came into Portland. I don't even know if he's still alive, but I think he is.

Arnie Solberg is a very nice person and well worth talking to, because he would actually know a lot of things I don't know. He worked with Dad. I just saw my dad working, and I was doing my thing and he was doing his thing; and I was very proud of what he was doing, but I was not involved in the process personally at all, other than just cheering him on [laughing].

MATTHEWS: Okay. Well, thank you.

[End of interview]

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